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The Effects of Option-Hedging on the Costs of Domestic Price Stabilization Schemes

Donald F. Larson
and
Jonathan Coleman

Whether a stabilization fund is hedged or not, it will inevitably generate large amounts of debt. But hedging the fund will make it more likely to survive in the short term.

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This paper — a product of the International Trade Division, International Economics Department — is part of a larger effort in PRE to improve the developing countries' management of commodity price risks. Copies are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Dawn Gustafson, room S7-044, extension 33714 (23 pages, plus 19 pages of annexes).

Casual observation leads to the conclusion that commodity-stabilization funds tend to be short-lived. While some funds may have failed because of poor management or unwarranted political interventions, the stochastic components of commodity prices can generate insurmountable difficulties for even the most expert managers. By transferring price risk from domestic producers and consumers to government-backed stabilization funds, these programs generate welfare benefits that end abruptly when the funds fail.

In the context of a price-taking country stabilizing domestic prices through variable border tariffs, Larson and Coleman annotate the circumstances under which fund resources face large or unlimited liability and provide a simple strategy of hedging with commodity options to limit fund risk. Using stochastic computer simulations, the authors demonstrate that using financial options will generate positive net welfare gains for the government agencies backing the funds. These results are quite robust under a number of underlying assumptions.

Positive net benefits stemming from fund hedging can occur even when the welfare gains to producers and consumers stemming from the stabilization program are small or nonexistent.

To the extent that international prices follow a log-normal random walk, the stochastic component of price variability can become overwhelming in relatively large samples of 500 observations increasing the error associated with price expectations and hampering the ability of fund management to determine long-run "reasonable" prices. While hedging techniques are perhaps more obviously useful when the stochastic component of price is large, similar risk benefits occur under simulations in which prices are deterministic and only international supplies contain a random component.

Hedging techniques will not render the funds immortal; they will generate revenue-based risk benefits for governments backing the funds, and can generate benefits to producers and consumers by extending the probable lives of the stabilization schemes.

THE EFFECTS OF OPTION-HEDGING ON THE COSTS OF DOMESTIC PRICE STABILIZATION SCHEMES

TABLE OF CONTENTS

Introduction

Commodity prices are notoriously unstable and many countries, both industrial and developing, intervene in commodity markets in order to limit the range of price movements. Sometimes the interventions require international efforts in the form of commodity agreements[1] which attempt to use the market power of major producers and sometimes consumers to stabilize global prices; other programs are unilateral in nature and are designed to defend prices within national borders. While the mechanisms are varied, a common characteristic of almost all such programs is their eventual failure. There are multiple reasons for the failure of the various schemes, and some of the reasons are related directly to the form of the stabilization program[2]; however, a constant strain on any stabilization program is the stochastic component of commodity prices which renders the financial, or in the case of buffer stocks, the physical exhaustion of resources a statistical eventuality.

In this paper a simple simulation model is used to derive several results. First, different samples of prices generated by a log-normal random walk can exhibit remarkably different sample-distribution characteristics. This is not a new result -- see Wright and Williams (1990)-- but serves to emphasize that, as a practical matter, stabilization fund managers must treat the future as unchartable even when expectations are rational; that is, even when market agents are fully aware of the deterministic and stochastic components of price movements. Secondly, the simulations demonstrate that price-band stabilization methods, similar to those currently used in Chile and Papua New Guinea are fairly neutral in long-term effects, including inefficiency losses, but that single-period income effects can be quite large. In addition, the over-all "risk" benefits coming from reduced price variability tend to be small. Finally, by operating a stabilization scheme, the government transfers the risk of large price movements from producers and consumers to the government and tax payers, or more particularly, to the financial or physical assets of some stabilization fund or buffer stock. The simulations show that simple hedging strategies can greatly reduce the variability of fund revenues and payments. By limiting the extreme payouts from the fund, such hedging can extend the probable life of the stabilization scheme. Hedging does not, however, offer immortality. These results

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[1]McNicol (1978) documents 17 major commodity agreements since the close of World War I.

[2]See Knudsen and Nash (1990) for a description of a wide range of stabilization programs.

are quite robust across a wide range of assumptions. In addition, the gains-to-hedging results were shown to be independent of the assumption that prices follow a random-walk.

In building the simulation model, some very broad assumptions needed to be made about the basic way in which the modeled market was to operate and these basic assumptions are maintained throughout the paper. Included are the assumptions that the country is a price-taker, that expectations are rational, and that the country attempts to limit domestic price movements via a price-band mechanism that draws its financial backing either from general government revenues or from a special buffer fund.

The price band outcomes and fund revenues

Consider a price-taking country which hopes to stabilize domestic prices around some moving average of international prices. For such a country there are nine exhaustive possible states defined by the relationships between border prices, the price-band, and trade flows; the price-band may fall in a range in which the country would always be a net exporter, a net importer, or the price band may straddle the point at which domestic supplies equal domestic demand. In addition, the border price may fall above the band, below the band, or within the band. In operating a price-band program, price-risk is transferred from the producers and consumers to the government or stabilization fund. The government fund gains revenues in some of the states and pays out in other states. In four of the nine possible states the stabilization mechanism would produce revenue; in two of the nine states the mechanism would generate a loss; and in three of the states there would be neither a pay-out nor revenues generated.

Figures 1-3 illustrate the three possible states if the country is a perennial exporter of the "stabilized" commodity. In Figure 1, the border price (Pw) falls above the upper limit of the price band. In order to peg domestic prices at the top of the band (Pu), the government would impose an export tax equal to Pw minus Pu. If producers correctly anticipate the prevailing domestic price, Qs will be produced. At the prevailing price of Pu domestic demand will be Qd. Qs minus Qd will be exported generating (Pw-Pu)*(Qs-Qd) in revenues for the government. Figure 2 illustrates the state in which the border price falls below the lower range of the band (Pl). In this case, the government must first impose an import tax equal to (Pl-Pw) to prevent less expensive foreign supplies from filling domestic demand, then subsidize exports (Qs-Qd) by (Pl-Pw). The import tax will generate

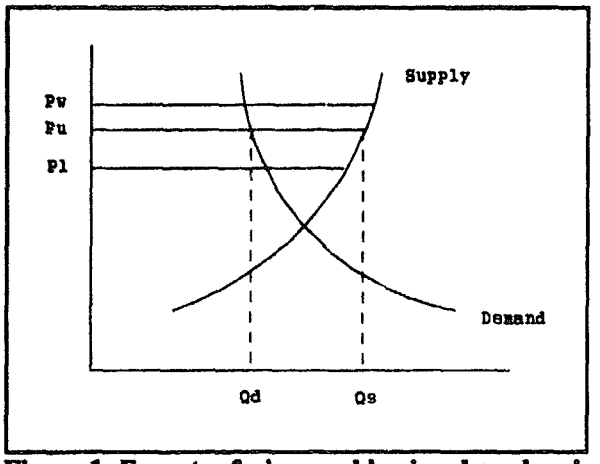

Figure 1: Exporter facing world price above band.

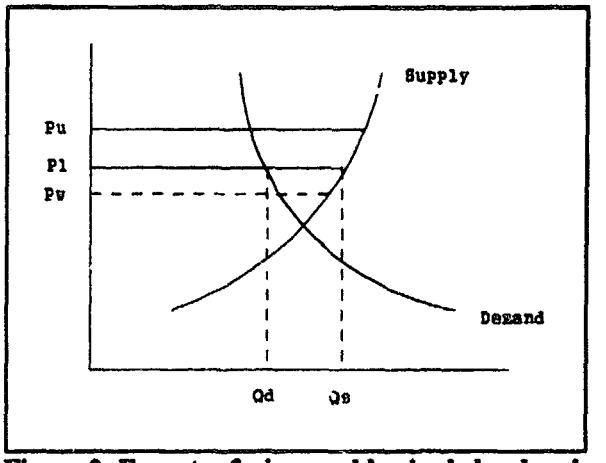

Figure 2: Exporter facing world price below band.

no revenues, and the net loss of revenues from the government or stabilization fund would equal (Qs-Qd)*(Pl-Pw). In Figure 3, the border price falls within the price band; import and export taxes are set to zero and the fund neither gains nor loses revenue.

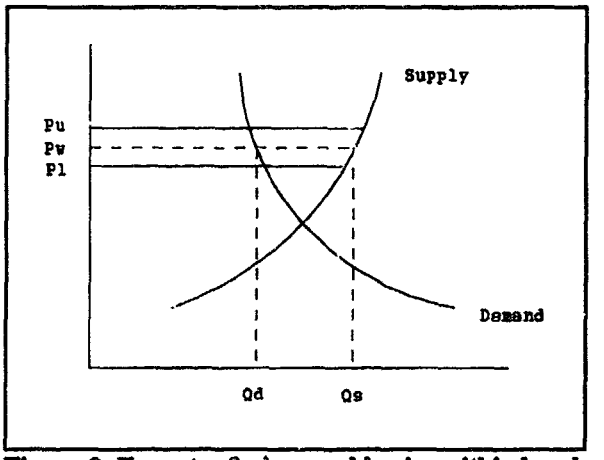

Figure 3: Exporter facing world price within band.

Figures 4-6 illustrate the three importing states In Figure 4, the border price falls above the price band. The government must impose an export tax equal to (Pw-Pu) to prevent domestic supplies from flowing to the more

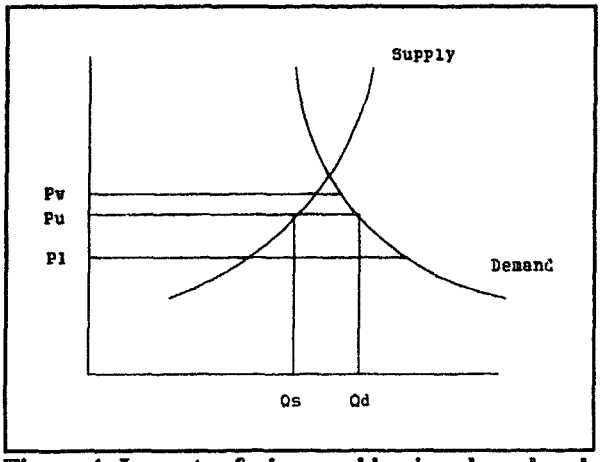

Figure 4: Importer facing world price above band.

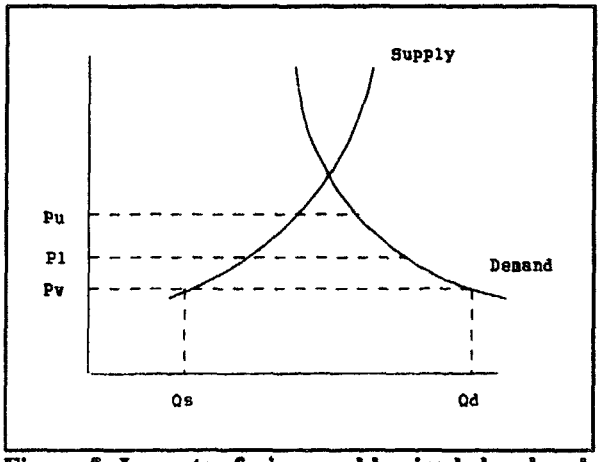

Figure 5: Importer facing world price below band.

profitable export market. In addition, imports (Qd-Qs) must be subsidized by (Pw-Pu). In this state the fund loses (Pw-Pu)*(Qd-Qs). Figure 5 illustrates the importing case when the border price falls below the price band. The government imposes an import tax equal to (Pl-Pw) which generates (Qd-Qs)*(Pl-Pw) in revenue for the stabilization fund. Figure 6 shows the state where the border price falls within the band, generating neither revenue nor losses.

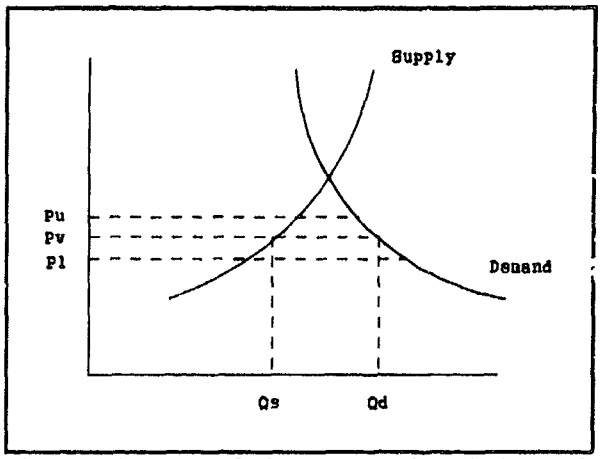

Figure 6: Importer facing world price within band.

Finally Figure 7 illustrates the case when the price band straddles the point at which domestic supplies equal domestic demand. When the border price falls above the upper range of the price band the country will be a net exporter. To bring the domestic price in line with the price band (Pu), the government must impose an export tax equal to (Pw-Pu) which generates revenues equal to (Pw-Pu)*(Qs-Qd). When the world price (Pw') falls below the price band, the country is a net importer. The government imposes an import tax equal to (Pl-Pw') and collects revenue equal to (Pl-Pw')*(Qd'-Qs'). If the price falls within the band, the country may either import or export, but tariffs will be set to zero and no revenues will be generated or lost.

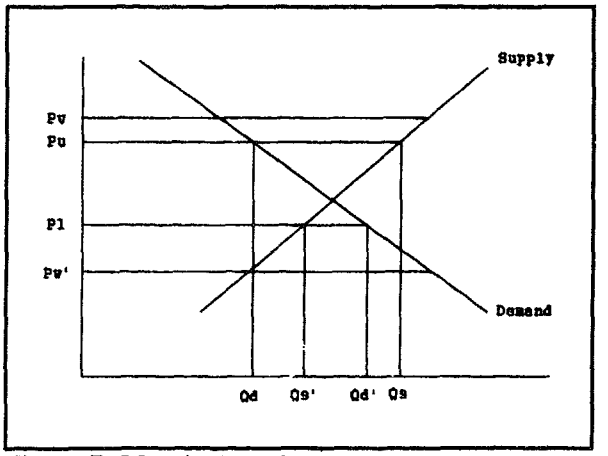

Figure 7: Marginal trader.

Welfare gains and losses

By intervening in the domestic market the government generates welfare transfers between consumers and producers as well as efficiency loses. These transfers occur for each period the government or fund manager intervenes and may have off-setting effects. In fact, one of the advantages of a price-band mechanism is that the average effect on domestic prices is neutral-- see Coleman and Larson (1990). In addition, by stabilizing the price

component of producer income the program also generates a stabilization benefit which occurs over the life of the program. Efficiency losses[3] and the monetary transfers between producers, consumers, and the government are readily calculated through changes in the traditional measures of consumer and producer surplus which analyze areas under the demand and supply curves. These measures give a general indication of the welfare gains and losses for each period in which the government intervenes.[4]

Figure 8 illustrates the consumer, producer, and government surpluses generated by imposing an export tax on an exported good in order to lower domestic prices. Domestic prices fall from the border price of P to P' as the government imposes a tax equal to (P-P'). Demand increases from Qd to Qd' and supplies decline from Qs to Qs'. The government receives revenues equal to area d; producer surplus drops by an amount equal to the sum of areas a,b,c,d, and e; consumer surplus increases by an amount equal to areas a and b, leaving an efficiency loss equal to areas c and e. Generally speaking, consumer surplus is given by:

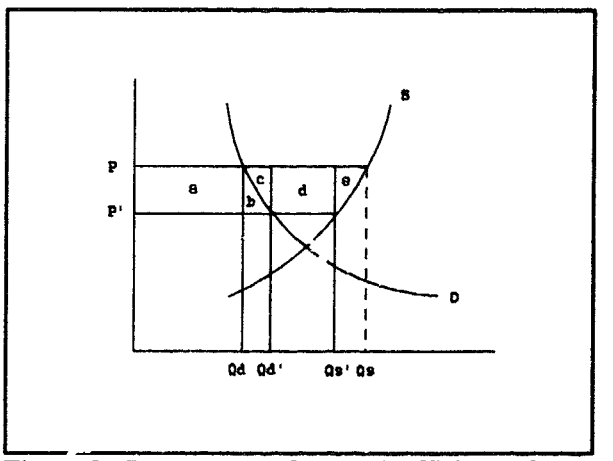

Figure 8: Income transfers and efficiency losses under an export tax.

$$\Delta CS = -\int_{p^0}^{p'} D(p)\,dp, \qquad (1)$$

where P and P' are the original and alternative prices respectively, and where demand D(p) is a function of price.

[3]Once expected price replaces price in the supply equation, efficiency losses need not be negative. This result comes from the fact that a price band can accidentally provide a domestic price that is closer to the actual prevailing price than the expected price, generating a positive efficiency gain.

[4]Only under very strong assumptions do ordinal monetary measures of consumer surplus correspond to unique measures of consumer welfare. However, for applied work there are few practical alternatives. See Just, Hueth, and Schmitz (1982), chapter 5 for a discussion of consumer surplus and applied economic analysis.

Producer surplus is similarly defined as:

$$\Delta PS = \int_{p^0}^{p'} S(p)dp \tag{2}$$

The change in government revenues is given by:

$$\Delta GR = [S(p') - D(p')][p^0 - p']. \tag{3}$$

The efficiency loss is defined as:

$$EL = \Delta CS + \Delta PS + \Delta GR \tag{4}$$

The way in which income is transferred, or lost to inefficiencies, will vary depending upon the type of government intervention and will differ from period to period as the type of intervention needed to defend a price band changes with international price movements. In general, the transfers between producers, consumers, and the

Table 1: Producer, consumer, and government surplus gains and losses under a price-band stabilization scheme.

	Border price		
Trade State	**Above band**	**Within band**	**Below band**
Exporter			
Consumer surplus	gain	neutral	loss
Producer surplus	loss	neutral	gain
Fund revenue	gain	neutral	loss
Marginal trader			
Consumer surplus	gain	neutral	loss
Producer surplus	loss	neutral	gain
Government revenue	gain	neutral	gain
Importer			
Consumer surplus	gain	neutral	loss
Producer surplus	loss	neutral	gain
Government revenue	loss	neutral	gain

government stabilization fund are likely to be offsetting. Inefficiency losses, however, are not offset and are a general social cost incurred by operating a price stabilization program. Table 1 lists the income transfers associated

with each of the possible nine states that can occur under a price-band scheme.

To the extent that producers prefer stable incomes to unstable incomes, additional benefits accrue over the life of the stabilization program based on the efficacy of the program in reducing income variability by reducing the variability of the price component of producer income.[5] Newbery and Stiglitz (1981) derived a quantifiable measure of the value of the income stabilization achieved based on assumptions concerning the relative risk aversion for producers. Assuming that producers can be treated as a single aggregated agent whose utility can be represented by a Von-Newman Morgenstern Utility function of income U(Y), average benefits relative to income are defined as:

$$\frac{B}{\bar{Y}_0} = \frac{\bar{Y}_1 - \bar{Y}_0}{Y_0} - \frac{1}{2}R(\bar{Y}_0)\left[\sigma^2_{Y_1}(\bar{Y}_1/\bar{Y}_0)^2 - \sigma^2_{Y_0}\right] \qquad (5)$$

where B is the money value of the stabilization benefits; Y_0, Y_1 represent income without and with a stabilization program, respectively, and a bar over a variable represents the variable's mean; where σ^2_y is the square of the coefficient of variation for the income Y; and R is the coefficient of relative risk aversion given by:

$$R = -Y\frac{U''(Y)}{U'(Y)} \qquad (6)$$

The first term in (5) is a transfer benefit resulting from any change in the mean level of income, while the term following the addition sign measures the benefit directly attributable to a reduction in the variance of income resulting from a reduction in the variability of price. The derivation of the benefits formula is given in Annex II.

Producer versus fund risk

By intervening at the border, a government operating a price-band scheme commits its own resource to offset a portion of the range of international price movements. Consumers and especially producers gain a risk-benefit because the risks associated with international price movements are transferred from individuals to the

[5]Potentially, there is a gain to consumers from stable prices-- see Newbery & Stiglitz (1981), chapter 9; however, if consumption substitutes are readily available or expenditures on the good are small relative to income, the benefits will be quantitatively small.

government. Generally, this is assumed to produce a net gain in welfare as the government is assumed to be less averse to the risk associated with price movements than individual producers. This is consistent with one of the few empirical studies of risk aversion. Using games of chance in rural India to measure attitudes toward risk, Binswanger (1978) concluded that relative risk aversion tended to increase as the gamble increased as a portion of wealth. To the extent that the total resources of the government are less volatile as a result of price movements relative to producer incomes, a stabilization scheme and the transfer of risk should produce a flow of benefits.

Although it appears trivial to do so, it should be noted that the derived benefits of a stabilization scheme flow only if the stabilization scheme remains operational. Mundlak and Larson (1989) have shown that changes in international prices tend to lead to changes in domestic producer prices, despite an ample number of programs designed to mitigate such effects. This result is more general, but consistent with the recognized failure of most international commodity stabilization schemes. Wright and Williams (1990) note that stabilization schemes "almost never succeed for very long-- and I do not mean long in the Keynesian long run. The founders easily survive the life span of the typical scheme, physically if not financially." The recent demise of two highly-regarded stabilization schemes, wool in Australia, and programs for cocoa, palm oil, copra, and coffee in Papua New Guinea emphasises the fragile nature of stabilization programs. And when formerly successful stabilization programs do fail, it is unclear whether the benefits accumulated during the functioning life of the program outweigh the abrupt market reactions and the ensuing adverse effects as the mechanism crumbles.[6]

Stabilization programs can use discretionary rules to stabilize prices around some expert or legislated notion of the correct long-run prices or can use fixed rules to define the range in which prices should be defended.[7] Unfortunately, computer simulations demonstrate that extremely simple price movements, such as a log-normal random walk, can lead to extreme price distributions. Stabilization schemes which require the defense of

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[6]Akiyama and Varangis (1989) simulated the long-term effects of the International Coffee Agreement and concluded that the long-term production and price effects of the agreement were small but that the short-run effects of the agreement's dissolution were large.

[7]The Australian Wool Fund is an example of the former and the Papua New Guinea stabilization programs examples of the latter.

unreasonable price levels will fail and fail rapidly; however, there remains a great deal of uncertainty as to whether a "reasonable" price band can ever be defined. For example, Wright and Williams (1990) used computer simulations to demonstrate that a simple autocorrelated price mechanism can generate samples of 50,000 observations in which there remains a greater than 5% chance of improperly identifying a stationary-mean by more than a standard deviation.

Rules can be used to generate a stabilization scheme that contains some feed-back and therefore some adjustment mechanism. However, as the simulations later demonstrate, the ability of the fund to remain liquid, given a limited borrowing capacity, is primarily a matter of luck. This is perhaps the most frequent reason why stabilization schemes fail. At the same time, the following section lays out a strategy of hedging which can greatly reduce the variability of stabilization fund payouts and thereby help the fund manager survive small doses of bad luck.

Hedging fund risk

Of the nine possible states relating prices and trade which can occur under a price-band mechanism, only 2 create a liability for a stabilization fund, while four of the states generate revenues (see Table I.) In addition, the liability faced by the fund is limited; however, the limit may be quite large. Conversely, the potential for tax revenue is not bounded. Figure 9 illustrates the case for an exporter. The area above the price band and between the supply and demand curves is unbounded above and represents the potential area that the could be used to finance a stabilization fund via an export tax. The area between the lower range of the price band and the demand and supply curves at Pl down to the axis represents the maximum payout from the fund for an exporter. However, the value of this area goes to zero as the lower range of the price band falls. A similar situation exists for the other

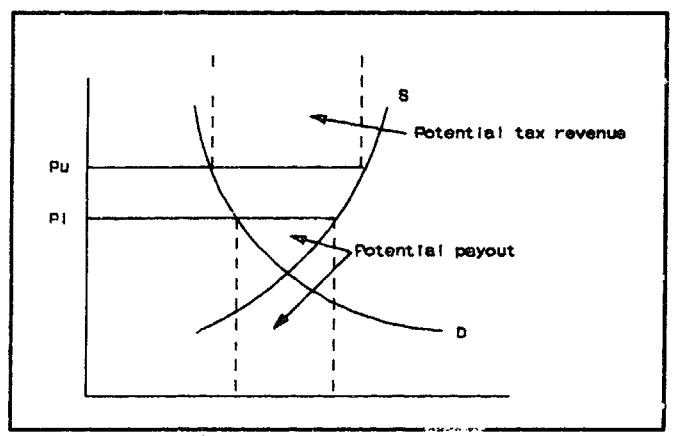

Figure 9: Potential tax revenue and fund payouts.

"liable" state, the case of subsidized imports.[8] For the exporter case, the maximum fund liability has the following characteristics as prices fall:

$$\lim_{p_l \to p_m} (p_l - p)[S(p_l) - D(p_l)] = 0, \tag{7}$$

where $S(p_m) = D(p_m)$.

For the case of the importer:

$$\lim_{p_u \to p_m} (p_u - p)[S(p_u) - D(p_u)] = 0, \tag{8}$$

where $S(p_m) = D(p_m)$.

For commodity markets in which futures are available, the fund can further restrict the payout by buying options to hedge the fund's liability. Consider the following example. In period one, producers, consumers and fund managers know what the price band will be, but do not know the stochastic component of the international price. Furthermore, the fund manager knows the demand and supply curves of the relevant commodity. In period two, the stochastic component and therefore the international price will be revealed and the fund manager will have to defend the price band. In order to limit the potential payout from the fund, the fund manager looks at the range of the prices covered by the band. If the country would export over the entire range of the band (see Figure 2), the fund faces a liability only if the international price in period 2 were to fall below the lower range, that is, below Pl. Therefore to hedge that liability, the fund manager hedges the quantity S(Pl)-D(Pl) by purchasing put-options at a strike price of Pl, for a delivery date corresponding to period 2. Should the border price actually fall below Pl, the added value of the put option would compensate the fund for additional outlays. The fund's liability is thereby limited to the purchase cost of the options.

In the case where the range of the price-band implies that the country will be an importer, the fund is liable when the border price falls above the upper bound of the price-band range (see Figure 4.) In this case, the fund manager can limit the fund's liability by hedging the quantity [D(Pu)-S(Pu)] through the purchase of calls for a

[8]In the importer case, total import tax revenues are bounded as well, but only by the nonnegativity condition on prices.

strike-price of Pu for delivery in period 2. Should the border price fall above Pu, the increased value of the call options would compensate the fund for additional payouts.

The value of the strategy will of course depend upon the nature of the stochastic price element and the path of the resulting prices. Analytic answers may be derived based on the underlying parameters of the problem and price expectations; but while such results may hold under large-sample conditions, the small-sample properties are more important as a practical matter. In order to calculate the benefits of a stabilization program as well as the returns to hedging to consequential fund risks, a computer simulation model was constructed which is presented in the following section.

Model description: production and the price-band mechanism

The model is designed to simulate a fairly simple set of actions for producers, consumers, and government officials operating in a price-taking country which has instituted a price-band and uses import tariffs and subsidies to defend the band. The band operates for a single crop for which there are no close substitutes. In order to finance the enforcement of the band, the fund may freely borrow in simulation. The crop is annual and takes 120 days to mature. At the beginning of the period farmers evaluate their expectations of the price they will receive for their crop and plant accordingly. Expectations are rational. In the case where international prices (p^i) are assumed to follow a log-normal random walk[9], i.e.,

$$p_t^i = p_{t-1}^i * *_t, \text{ where } \ln(\epsilon) \sim N(\mu,\sigma) \tag{9}$$

$$E(\epsilon) = e^{\mu+\frac{1}{2}\sigma^2}, \tag{10}$$

so that

$$\ln E(p_t^i) = \ln p_{t-1}^i + \frac{1}{2}\sigma^2, \text{ when } \mu = 0 \tag{11}$$

When the government operates a price-band, the farmer is assumed to fully recognize the consequences of the band and adjust his expectations of the domestic price (p^d) accordingly so that

[9]See Aitcheson and Brown (1957) for a discussion of expectations and log-normal errors.

$$p^{l}_{t+1} \leq E(p^{d}_{t+1}) \leq p^{u}_{t+1}, \tag{12}$$

where the upper (p^u) and lower (p^l) prices given by the price-band rules are known without error to the farmer.

Domestic production is a function of expected domestic prices, while total demand occurs 120 days later and is a function of actual domestic price, i.e., after the random element has been revealed. Trade makes up the gap (positive or negative) between supply and demand. The demand and supply curves are assumed to be log-linear and are of the form:

$$\ln S_t = \ln(100) + e_s \ln E(p^d_t) \tag{13}$$

and

$$\ln D_t = \ln(100) - e_d \ln(p^d_t), \tag{14}$$

where e_d and e_s are constant demand and supply elasticities.

The fund manager evaluates expected supply and demand and therefore trade at both the upper and lower levels of the price band. If, over the band, the country is exclusively and importer or exporter (that is, the country is *not* a marginal trader) then he hedges the fund's liability: purchasing puts at a strike price equal to the lower level of the price-band if the country exports at that price level, or buying calls at a strike price equal to the upper level of the price band if the country expects to import the commodity. The quantity hedged is equal to the trade volume at the strike price. The prices of the options are calculated using the Black-Scholes option-pricing model and is based on expected prices, an annualized interest rate of 6.0%, and an expected coefficient of variation based on a five-period moving average calculation. Each option is held for 120 days. After 120 days, the true price is revealed as is domestic consumption and trade. Based on the revealed price, the manager liquidates the options if they have value, collects any relevant taxes, and pays out any relevant subsidies based on actual trade. The demand and supply elasticities used throughout the base-run of the simulation were -0.5 and 0.8 respectively.

Simulation results on prices and welfare changes

The model described above was used to generate ten samples, each containing observations for 500 iterations. The simulations were dynamic within each of the samples, that is, at the beginning of each of the ten samples the international price was set to 1 with a random walk generating prices for the next 499 observations in the sample. The fund manager started each sample with zero reserves, but could borrow freely. The manager operated a price-band system with the upper and lower bands based on 110% and 90% of a five-period moving average, respectively. Table 2 summarizes the settings for the control variables in the base-simulation.

Table 3 summarizes some of the simulation results for the price variables and reveals the underlying

Table 2: Control variable settings in base simulation.

Description of Control variables	Settings
Sample size	500
Number of samples	10
type of price movement	log-normal random walk
error distribution	log of error is distributed N(0,.01)
price expectations	rational
starting value of price	1.0
initial stabilization fund value	0.0
initial trading volume	self-sufficient, 0 exports
price band rules	plus/minus 10% of moving five-period average
option pricing method	Black-Scholes
delivery date on underlying future	120 days
period option held	120 days
interest rate	6.0%
C.V. used in option pricing	based on moving five-period sample
domestic demand elasticity	-0.5
domestic supply elasticity	0.8

difficulties faced by the fund manager.[10] Even though he may understand the underlying price mechanism as well as the intricacies of his own domestic market, the cumulative effects of random components can lead to very different price paths. Recognizing a "reasonable" long-run price may be impossible and, even if possible, irrelevant

[10]A more complete reporting is given in Annex I.

Table 3: Summary results for key price variables across base scenario simulated samples.

Variable	Mean range across samples	Minimum value	Maximum value
Border price	0.20 to 13.77	0.02	49.18
Domestic price	0.20 to 13.73	0.02	47.61
Log of error	0.00 to 0.01	-0.36	0.38

in the "short-run" --the short run in this case being 500 years.

Before turning to the question of how the fund is financed, it is perhaps best to consider how the stabilization program performs. While results from all ten base simulation samples are given in Annex I, Table 4 provides some summary results for three of the samples from which several conclusions can be drawn. Firstly, the information on domestic and border prices restates, in a slightly different way, the information contained in Table 3 and supports the general conclusion that the random component of the price structure can generate very different sample price distributions. This is reflected in the differing ranges within samples and the varying means and coefficients of variation across samples. The second implication is that the average effects of the price-band system on producer, consumer, or government welfare are small (less than 2% of average producer income), while the single-year effects can be quite large (multiple factors of average producer income.) The price-band system is able to reduce the coefficient of price variation as well as producer income variability, but again, the average effects are quite small. The stabilization programs are roughly self-financing, but the year-to-year variation in revenues or payments is quite large.

Table 5 provides the value of the stabilization program to producers as a percentage of their non-stabilized

Table 4: Summary results on welfare effects for selected simulation samples.

Variable	Mean	Minimum	Maximum	C.V.
Sample 1				
World price	0.30	0.03	1.21	98.63
Domestic prevailing price	0.30	0.03	1.14	97.16
Consumer welfare change	-0.75	-28.14	23.86	-898.59
Producer surplus change, exclusive of risk benefits	0.02	-17.86	9.39	11,830.86
Government surplus change, without hedging	0.45	-16.76	20.53	1,125.37
Standard efficiency loss	-0.29	-6.08	4.70	-325.76
Producer income without stabilization program	22.28	0.65	127.47	136.97
Producer income with stabilization program	22.31	0.66	123.18	134.83
Sample 4				
World price	12.53	1.04	49.18	85.48
Domestic prevailing price	12.38	1.04	47.61	85.31
Consumer welfare change	1.96	-45.94	47.77	565.85
Producer surplus change, exclusive of risk benefits	-51.81	-2,495.25	2,299.26	-715.08
Government surplus change, without hedging	54.74	-3,421.58	3,337.53	884.98
Standard efficiency loss	4.89	-1,151.17	940.21	3,197.41
Producer income without stabilization program	5,532.67	104.19	33,974.97	124.33
Producer income with stabilization program	5,454.95	104.19	32,851.00	124.07
Sample 9				
World price	0.35	0.05	1.31	80.85
Domestic prevailing price	0.35	0.05	1.31	80.72
Consumer welfare change	-0.48	-32.32	25.07	-1,316.90
Producer surplus change, exclusive of risk benefits	0.18	-16.67	16.49	1,412.03
Government surplus change, without hedging	0.04	-21.79	16.87	11,228.17
Standard efficiency loss	-0.27	-8.65	3.54	-394.74
Producer income without stabilization program	25.29	1.04	148.73	125.04
Producer income with stabilization program	25.56	1.05	148.73	124.29

revenues.[11] The results, which are expressed as a percentage of producer income, are quite revealing. Across all simulations, the values of the stabilization programs to producers were exceedingly small. While it can be argued that relative risk aversion changes at varying levels of income, it is clear that, on average, a very low tariff (for net importers) or export subsidy (for net exporters) would generate the same level of income benefits to producers as does a more complicated stabilization program. Across all of the samples, producers received a non-negative net welfare gain (transfer benefit plus risk benefit) from the stabilization programs, but not all risk benefits were positive, despite the fact that the stabilization programs were successful in reducing the variability of prices. In samples 2

[11]For the purposes of evaluating the simulation benefits, the coefficient of relative risk aversion given in equations 5 and 6 was assumed to equal 1.5.

and 9 the reduction was so small, however, that the adjustment for income changes -- see equation (5) -- overwhelmed the small reduction in income variability.

Table 5: Producer transfer and risk benefits to simulated stabilization programs.

Sample	Transfer benefit	Risk benefit
	---------- % ----------	
1	0.13	4.00
2	1.07	-0.38
3	0.22	0.62
4	-1.40	3.70
5	0.15	2.94
6	0.39	2.65
7	-1.35	5.98
8	-0.23	0.64
9	1.05	-1.06
10	0.35	2.92

Simulation results on fund financing

Results from the previous section indicated that while the benefits of a stabilization program may be small, the programs tend to be self-financing and can generate substantial single-period income benefits. Results in Table 6 show that borrowings are often needed to keep the fund in operation, and that the frequency and value of the borrowings will usually be reduced through hedging. Fund borrowings will not necessarily be eliminated by hedging and the primary determinant of whether or not the fund must borrow heavily is luck. This fact is underscored by the great range of indebtedness the samples generated. In some cases the fund blithely passed the entire period with positive balances, while in other

Table 6: Effects of hedging on stabilization fund borrowing.

	Number of times fund borrows		Maximum debt as percentage of average producer income	
Sample	Unhedged	Hedged	Unhedged	Hedged
1	0	0	--	--
2	6	5	-3.31	-5.23
3	262	0	-130.89	--
4	0	0	--	--
5	156	18	-73.76	-20.67
6	12	0	-43.91	--
7	22	22	-0.00	-0.00
8	13	0	-0.54	--
9	51	59	-170.34	-197.85
10	161	157	-392.01	-381.03

cases, the fund manager was forced to borrow the equivalent of the value of four year's worth of production.

What then, is the value of hedging to a fund manager? Assuming that the government or agency administering the stabilization scheme has an aggregate utility function that can be characterized in the same manner

as that of the producers, transfer and stabilization benefits derived from hedging activities can be calculated using an identical approach. Define average government benefits from hedging as:

$$\frac{B^g}{\|\bar{T}_0\|} = \frac{\bar{T}_1 - \bar{T}_0}{\|\bar{T}_0\|} + \frac{1}{2}R^g(\bar{T}_0)[\sigma^2{}_{T_1}(\bar{T}_1/\bar{T}_0)^2 - \sigma^2{}_{T_0}], \tag{15}$$

where T_0 and T_1 are average net revenues (taxes minus subsidies) under a stabilization program with and without hedging operations-- a bar over the variable represents the mean of that variable; σ^2_T is the coefficient of variation associated with flows in and out of the fund; and R^g is the government's coefficient of relative risk aversion with respect to fund flows.[12] It is assumed throughout the remaining analysis that the government is unitarily risk-averse, i.e. that $R^g = 1$. The hedging operation generates a pure transfer (positive or negative) between the fund and speculators who take the opposite position on fund option trades--the first term in equation (14), plus a "risk" benefit which comes from reducing the variability of the fund flows. Both are expressed as a share of the average "unhedged" fund income.

Table 7: Effects of hedging on fund income and fund risk.

Sample	Average fund flow		% C.V. of fund income		Benefits as % of fund income	
	Unhedged	hedged	Unhedged	Hedged	Transfer	Risk
1	0.45	0.52	1,125	878	16	1,097
2	0.32	-0.21	942	1,240	-27	371
3	-0.93	1.97	-4,489	1,715	-310	35,822
4	54.74	86.21	884	477	58	1,089
5	0.03	0.13	18,129	3,506	345	424,956
6	0.28	0.37	1,795	1,187	32	3,915
7	12.77	26.77	2,130	902	110	4,810
8	7.52	44.86	6,100	853	496	56,600
9	0.04	0.02	11,228	17,786	-43	116,543
10	0.00	-0.04	--	--	--	--

The effects of hedging the fund revenues are reported in Table 7. Since the average income flows into the

[12]When the fund is hedged the costs of purchasing the options as well as the revenues generated by exercising "winning" options are included in T.

fund are close to zero, the traditional measures of benefits, which are expressed as a percentage of income, take on very large values; however, it is clear from the large reduction in the C.V. of fund income that the hedging strategy usually reduces the variability of fund income flows. The income transfers which measure the simple value of the strategy are both positive and negative; the calculated value of the benefit of reducing the variability of the fund flows are all extremely large with regard to the average fund income.

While the benefits of the stabilization scheme in general may be suspect, the benefits of hedging an existing stabilization fund are clear and substantial under the assumptions made to this point. The following sections are devoted to testing the robustness of these results under different assumptions.

Alternative scenarios

As discussed earlier, fund liabilities can only exist when the price-band does not include the price at which the country would be self-sufficient. However, when the country is either exclusively an exporter or importer over the range of possible prices, only three possible states can exist: one of which is revenue neutral, one which generates revenues for the fund and one which taps the fund's resources. To test whether the simulation results reported earlier are sensitive to a change in the possible states, two alternative scenarios were simulated. By shifting supply and demand intercepts, the simulation model was adjusted to simulate exporter and importer nations.

In practice, price-band schemes are often based on nominal prices, since measures of inflation are frequently revised. At the same time, since the price-band rules are often based on moving averages, current inflation enters the price band with a lag. Under such circumstances, the upper limit of the price-band becomes more binding than the lower band. By adding a positive drift term, the model was altered so that nominal prices would slowly rise throughout the simulation periods.

The effects of these alternative simulations on producer welfare are reported in Table 8. More detailed results on the simulations are reported in Annex I. As in the base simulation, the net effects on producer welfare are all relatively small; however, the risk benefits are slightly larger (and all positive), especially for the case in which nominal prices drift upward.

Table 9 reports the alternative simulation effects on government welfare. Again, the results are consistent

Table 8: Producer benefits under alternative simulation scenarios.

Sample	Importer case		Exporter case		Upward drift case	
	Transfer	Risk	Transfer	Risk	Transfer	Risk
	%					
1	-1.6	9.8	1.0	0.4	-2.0	5.8
2	-0.6	3.5	-1.1	4.9	-2.6	17.7
3	-10.0	3.9	-0.3	3.0	-2.2	6.1
4	-0.3	1.2	-1.5	5.3	-4.8	54.8
5	-0.6	2.6	0.4	5.7	-1.4	3.7
6	-1.2	5.1	-0.2	6.8	-2.0	12.6
7	-2.6	18.9	-0.9	5.4	-2.4	8.4
8	-0.4	1.6	-0.6	2.2	-1.1	2.0
9	-1.6	3.0	-1.9	9.7	3.7	73.4
10	-2.8	18.8	-1.8	8.9	-0.7	1.9

Table 9: Government benefits under alternative simulations.

Sample	Importer case		Exporter case		Upward drift case	
	Transfer	Risk	Transfer	Risk	Transfer	Risk
1	-442	65,453	-97	1,844	39	368
2	288	232,001	111	3,851	23	252
3	-10	2,983	1,454	915,127	53	526
4	-22	59,181	98	2,409	11	112
5	-19	4,917	-183	14,261	68	113
6	-30	1,108	442	52,823	35	563
7	24	698	148	4,976	31	280
8	50	32,654	199	6,719	87	1,921
9	-23	1,246	31	414	73	1,190
10	-12	1,462	34	660	237	11,372

with earlier findings. Hedging the fund tends to generate quite large welfare gains to the extent that the government or fund agency is risk averse. All scenarios generated positive risk benefits, while the transfer effects were mixed, depending upon the luck of the draw. In the case of an upward price drift, the transfer benefits were positive as well since the government was able to tax more frequently.

Deterministic price movements

To this point, the results have been based on the assumption that price movements drift randomly. This

assumption is extreme in that behavioral forces inherent in supply and demand schedules have been ignored. In this section, an opposite, but equally naive alternative assumption is used to derive similar results. Rather than facing a random-walk international price, the price-taking country faces prices from a deterministic international commodity market consisting of supply and demand functions. International supplies are confounded by an additive random error. In general, economic markets are filled with both deterministic and stochastic components. Agents act on imperfect information about input prices and supplies, consumer income, and the prices of substitute and compliment goods. As in any system, if the economic processes are complex enough, the system variables may have many of the characteristics that we would normally associate with stochastic variables, even though they arise from a mixed stochastic-deterministic system. However, it is hoped that results that are consistent under two extreme assumptions in simulation, will prove robust in more complicated reality that falls somewhere between the two models.

In the expanded model, equation (9) is dropped and replaced by three additional equations and two more variables, international supply, S^i, and international demand, D^i. D^i contains domestic consumption, given in (14), but, consistent with the price-taking assumption, domestic demand is small enough relative to international demand that it can safely be ignored. The international demand schedule is assumed to be log-normal and is given by:

$$\ln D_t^i = \ln d_0 - e_d^i \ln(p_t^i) \tag{16}$$

where e^i_d is a constant international demand elasticity.

The supply equation is Nerlovian, implying a short-run supply elasticity different from the long-run steady-state supply elasticity and is given by:

$$\ln S_t = \ln s_0 + e_s^i \ln E(p_t^i) + l_s^i \ln S_{t-1} + v_t \tag{17}$$

where v is normally distributed $N(0,\sigma^2)$, where e^i_s is the constant short-run price elasticity and where $e^i_s/(1-l^i_s)$ provides the steady-state elasticity when $S_t = S_{t-1}$.

For simulation purposes, stock changes are set equal to zero so that:

Combining (16) and (17) into (18) yields:

$$S_t^i = D_t^i, \text{ for all } t. \tag{18}$$

$$\ln p_t^i = \frac{1}{(e_d^i - e_s^i)} \left[\ln(s_0/d_0) + l_s^i \ln S_{t-1} + v_t\right] \tag{19}$$

Noting that:

$$E\left[\exp\left(\frac{v_t}{e_d^i - e_s^i}\right)\right] = \exp\left[\frac{1}{2}\sigma^2\left(\frac{1}{e_d^i - e_s^i}\right)^2\right], \tag{20}$$

so that

$$E(p_t) = \left(\frac{s_0}{d_0}\right)^{\frac{1}{\gamma}} (S_{t-1})^{\frac{l_s^i}{\gamma}} \exp\left(\frac{\sigma^2}{2\gamma^2}\right), \quad \text{where } \gamma = \frac{1}{e_d^i - e_s^i} \tag{21}$$

In addition, since $D^i = S^i$ for all values of p including the steady-state S^i:

$$\ln s_0 = \left(1 - l_s^i\right) \ln d_0, \quad \text{since } \lim_{s \to 0} S^i(1) = D^i(1) \tag{22}$$

Table 10 summarizes some of the simulations results for the price variables using the deterministic model. Because of the feedback between international prices and international demand and supply, the range of values

Table 10: Summary results for key price variables across deterministic-model simulated samples.

Variable	Mean range across samples	Minimum value	Maximum value
Border price	0.99 to 1.02	0.62	1.55
Domestic price	0.98 to 1.02	0.73	1.33
Log of error	-0.01 to 0.01	-0.36	0.33

assumed by the price variables under simulation is much more narrow. Given the extremely limited price volatility

under the deterministic model simulations producer transfer and risk benefits generated by further stabilizing the domestic price were essentially zero for most of the simulations. (See Annex I for details.) However, even though the stabilization program themselves generated no real benefits, hedging the stabilization fund did prove to be a worthwhile endeavor.

Table 11 shows the effects of hedging on fund income and fund risk under the deterministic model

Table 11: Effects of hedging on fund income and fund risk under deterministic pricing model.

Sample	Average fund flow		% C.V. of fund income		Benefits as % of fund income	
	Unhedged	hedged	Unhedged	Hedged	Transfer	Risk
1	0.51	1.56	1,453	382	2	37
2	0.55	1.68	1,415	386	2	30
3	0.53	1.50	1,532	453	2	35
4	0.51	1.59	1,572	414	2	39
5	0.28	1.29	2,537	442	4	119
6	0.54	1.70	1,541	408	2	36
7	0.48	1.47	1,459	393	2	35
8	0.52	1.62	1,395	361	2	35
9	0.42	1.61	2,133	449	3	78
10	0.44	1.47	1,649	393	2	48

simulations. The results on hedging funds are consistent with those reported earlier. Since the feed-back of the deterministic-pricing model leads to similar price scenarios under each of the simulations, the results on fund-hedging are more consistent as well.

Conclusions

Casual observation leads to the conclusion that stabilization funds tend to be short-lived. While it may be that some funds have failed due to poor management or unwarranted political interventions, the stochastic components of commodity prices can generate insurmountable difficulties for even the most expert managers. Price-band schemes contain an element of information feed-back and offer transparent rules-- attributes which make such schemes preferable to many alternative mechanisms-- but the benefits to producers tend to be, on average, quite small. Similar average benefits can be generated with very small import taxes or producer subsidies. Nonetheless, such schemes can have large single-year effects.

The simulation results demonstrate that, if adopted, such funds should be hedged unless the government is not at all adverse to the fund's financial failure. Still, hedged or unhedged, such funds will, with eventual certainty, generate large levels of debt as a statistically "rare" sequence of events must eventually occur. By hedging, the funds are more likely to survive in the short-run.

Annex I: Simulation results for key variables

Table 1: Base simulation - summary statistics on simulation price variables.

Sample	Mean	Std Dev	Minimum	Maximum	% C.V.
Sample 1					
Log of error-term	-0.01	0.10	-0.27	0.27	-1580.66
World price	0.30	0.30	0.03	1.21	98.63
Domestic prevailing price	0.30	0.30	0.03	1.14	97.16
Expected world price	0.31	0.30	0.03	1.22	98.46
Expected domestic price	0.31	0.30	0.03	1.17	97.64
Sample 2					
Log of error-term	-0.01	0.10	-0.25	0.27	-1690.97
World price	0.20	0.24	0.02	1.14	119.49
Domestic prevailing price	0.20	0.24	0.02	1.08	118.71
Expected world price	0.20	0.24	0.02	1.14	119.64
Expected domestic price	0.20	0.24	0.02	1.09	119.00
Sample 3					
Log of error-term	0.00	0.10	-0.37	0.38	9248.85
World price	2.14	1.71	0.20	10.13	79.92
Domestic prevailing price	2.14	1.70	0.20	9.95	79.40
Expected world price	2.15	1.72	0.20	10.18	80.01
Expected domestic price	2.15	1.71	0.20	10.18	79.76
Sample 4					
Log of error-term	0.01	0.10	-0.23	0.27	1355.93
World price	12.53	10.71	[illegible]04	49.18	85.48
Domestic prevailing price	12.38	10.56	1.04	47.61	85.31
Expected world price	12.52	10.73	[illegible]01	49.43	85.67
Expected domestic price	12.43	10.65	1.01	48.57	85.66
Sample 5					
Log of error-term	-0.00	0.10	-0.33	0.32	-2869.57
World price	0.45	0.42	0.06	1.95	92.70
Domestic prevailing price	0.46	0.42	0.07	1.95	91.77
Expected world price	0.46	0.42	0.06	1.96	92.47
Expected domestic price	0.46	0.42	0.07	1.96	91.83
Sample 6					
Log of error-term	-0.00	0.10	-0.29	0.29	-2129.81
World price	0.38	0.32	0.09	1.52	85.50
Domestic prevailing price	0.38	0.32	0.09	1.40	84.49
Expected world price	0.38	0.33	0.09	1.53	85.35
Expected domestic price	0.38	0.32	0.09	1.43	84.62
Sample 7					
Log of error-term	0.01	0.10	-0.29	0.25	1782.93
World price	5.64	4.99	0.46	24.06	88.40
Domestic prevailing price	5.59	4.90	0.46	21.13	87.72
Expected world price	5.64	5.00	0.46	24.18	88.58
Expected domestic price	5.60	4.93	0.46	22.40	88.05
Sample 8					
Log of error-term	0.01	0.10	-0.32	0.26	1843.06
World price	13.77	10.48	0.62	35.85	76.12
Domestic prevailing price	13.73	10.45	0.68	34.48	76.11
Expected world price	13.81	10.55	0.63	36.03	76.38
Expected domestic price	13.80	10.54	0.66	36.03	76.40
Sample 9					
Log of error-term	-0.00	0.10	-0.36	0.33	-2731.12
World price	0.35	0.28	0.05	1.31	80.85
Domestic prevailing price	0.35	0.28	0.05	1.31	80.72
Expected world price	0.35	0.29	0.05	1.31	80.84
Expected domestic price	0.35	0.29	0.05	1.31	80.83
Sample 10					
Log of error-term	-0.00	0.10	-0.31	0.29	-2868.83
World price	0.31	0.23	0.08	1.49	74.63
Domestic prevailing price	0.31	0.23	0.09	1.39	74.08
Expected world price	0.31	0.23	0.08	1.50	74.88
Expected domestic price	0.31	0.23	0.09	1.47	74.47

Annex I: Simulation results for key variables

Table 2: Base simulation - Producer income, and changes in producer, consumer, and government welfare.

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 1						
Consumer welfare change	-0.73	-28.14	23.86	-898.59	-0.13	2.38
Producer welfare change, exclusive of risk benefit	0.02	-17.86	9.39	11830.86	-2.64	21.82
Government welfare change, without hedging	0.45	-16.76	20.53	1125.37	0.05	2.07
Government welfare change, with hedging	0.52	-11.10	20.53	878.92	0.79	1.93
Standard efficiency loss	-0.29	-6.08	4.70	-325.76	-1.50	11.35
Producer income without stabilization program	22.28	0.65	127.47	136.97	1.63	1.63
Producer income with stabilization program	22.31	0.66	123.18	134.83	1.56	1.28
Sample 2						
Consumer welfare change	-0.75	-33.75	17.39	-736.53	-1.20	5.50
Producer welfare change, exclusive of risk benefit	0.09	-9.22	16.96	1776.92	3.02	37.86
Government welfare change, without hedging	0.44	-13.60	16.67	941.98	0.46	2.83
Government welfare change, with hedging	0.32	-9.96	16.67	1240.11	1.08	2.50
Standard efficiency loss	-0.21	-9.59	3.76	-387.93	-4.70	43.65
Producer income without stabilization program	12.84	0.22	109.19	176.96	2.62	6.34
Producer income with stabilization program	12.98	0.22	108.34	175.23	2.54	5.71
Sample 3						
Consumer welfare change	-0.34	-54.15	28.80	-2597.42	-1.14	5.93
Producer welfare change, exclusive of risk benefit	0.56	-229.39	285.72	6593.82	1.30	20.29
Government welfare change, without hedging	-0.94	-361.08	259.05	-4489.22	-1.83	28.58
Government welfare change, with hedging	1.97	-258.11	259.04	1715.30	0.89	27.15
Standard efficiency loss	-0.71	-118.62	92.57	-1958.60	-1.79	26.48
Producer income without stabilization program	381.03	9.05	3117.33	122.11	2.82	10.34
Producer income with stabilization program	381.88	9.05	3060.14	121.50	2.79	10.06
Sample 4						
Consumer welfare change	1.96	-45.94	47.77	565.85	0.97	4.12
Producer welfare change, exclusive of risk benefit	-51.81	-2495.25	2299.26	-715.08	-1.36	16.23
Government welfare change, without hedging	54.74	-3421.58	3337.53	884.98	1.21	20.28
Government welfare change, with hedging	86.22	-1216.35	3337.53	477.41	4.09	23.18
Standard efficiency loss	4.89	-1151.17	940.21	3197.41	0.25	18.35
Producer income without stabilization program	5532.67	104.19	33974.97	124.33	1.79	2.38
Producer income with stabilization program	5454.95	104.19	32851.00	124.07	1.75	2.14
Sample 5						
Consumer welfare change	-0.43	-32.72	33.87	-1731.32	-0.01	4.21
Producer welfare change, exclusive of risk benefit	0.04	-38.14	38.10	13670.45	-0.03	22.19
Government welfare change, without hedging	0.03	-38.77	18.87	18129.65	-1.48	10.05
Government welfare change, with hedging	0.13	-23.45	18.87	3506.83	-0.10	4.46
Standard efficiency loss	-0.37	-15.78	6.05	-484.30	-3.84	28.84
Producer income without stabilization program	39.72	1.72	259.53	132.07	1.91	3.51
Producer income with stabilization program	39.78	1.90	259.53	130.38	1.83	3.14
Sample 6						
Consumer welfare change	-0.67	-33.39	29.84	-1055.71	-0.37	5.11
Producer welfare change, exclusive of risk benefit	0.08	-26.56	17.76	3755.69	-1.23	28.26
Government welfare change, without hedging	0.28	-27.03	21.43	1794.73	-0.60	6.72
Government welfare change, with hedging	0.37	-15.94	21.43	1186.66	0.78	4.81
Standard efficiency loss	-0.32	-8.50	4.83	-389.66	-2.75	15.25
Producer income without stabilization program	28.83	2.68	177.76	130.28	1.92	2.60
Producer income with stabilization program	28.94	2.81	157.74	128.42	1.83	2.08

Annex I: Simulation results for key variables

Table 2: Base simulation - Producer income and changes in producer. consumer, and government welfare (continued.)

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 7						
Consumer welfare change	1.18	-58.11	58.92	1006.08	-0.23	5.66
Producer welfare change, exclusive of risk benefit	-15.24	-1634.54	1335.14	-1525.73	-1.20	17.50
Government welfare change, without hedging	12.77	-1531.09	1776.72	2129.73	0.66	17.53
Government welfare change, with hedging	26.77	-1476.05	1776.66	901.53	2.19	21.51
Standard efficiency loss	-1.29	-500.74	393.93	-5100.16	-1.42	21.35
Producer income without stabilization program	1698.25	31.20	11479.36	126.22	1.80	2.87
Producer income with stabilization program	1675.39	31.20	10003.33	124.70	1.68	2.09
Sample 8						
Consumer welfare change	0.94	-48.19	42.82	1170.91	-0.31	4.58
Producer welfare change, exclusive of risk benefit	-9.57	-1395.64	2153.71	-3857.61	1.21	9.84
Government welfare change, without hedging	7.52	-2943.22	1850.00	6100.57	-1.19	10.78
Government welfare change, with hedging	44.86	-2384.77	1850.00	852.66	-0.14	12.31
Standard efficiency loss	-1.12	-1000.22	623.45	-11099.40	-1.06	15.98
Producer income without stabilization program	6261.17	52.06	21509.58	93.35	0.46	-1.17
Producer income with stabilization program	6246.81	56.56	20247.33	93.10	0.42	-1.24
Sample 9						
Consumer welfare change	-0.48	-32.32	25.07	-1316.90	-0.46	4.90
Producer welfare change, exclusive of risk benefit	0.18	-16.67	16.49	1412.03	1.49	21.79
Government welfare change, without hedging	0.04	-21.79	16.87	11228.17	-1.07	5.66
Government welfare change, with hedging	0.02	-15.56	16.87	17786.99	-0.12	3.27
Standard efficiency loss	-0.27	-8.65	3.54	-394.74	-3.75	22.55
Producer income without stabilization program	25.29	1.04	148.73	125.04	2.15	4.00
Producer income with stabilization program	25.56	1.05	148.73	124.29	2.07	3.56
Sample 10						
Consumer welfare change	-0.29	-25.49	19.08	-2155.42	-0.47	3.13
Producer welfare change, exclusive of risk benefit	0.05	-16.41	12.06	4715.44	-1.09	23.87
Government welfare change, without hedging	0.00	-18.94	16.43	99999.00	-0.27	3.65
Government welfare change, with hedging	-0.04	-14.03	16.43	-10888.66	0.69	2.68
Standard efficiency loss	-0.24	-6.16	6.99	-380.91	-1.25	18.64
Producer income without stabilization program	19.91	2.57	175.82	134.34	3.61	13.54
Producer income with stabilization program	19.98	2.68	164.28	132.41	3.43	11.86

Annex I: Simulation results for key variables

Table 3: Exporter case - summary statistics on simulation price variables.

Sample	Mean	Std Dev	Minimum	Maximum	% C.V.
Sample 1					
World price	356.39	743.53	0.89	3580.88	208.63
Log of error-term	0.01	0.10	-0.25	0.27	690.78
Domestic prevailing price	351.42	738.41	0.89	3074.59	210.12
Expected world price	355.18	745.66	0.89	3598.83	209.94
Expected domestic price	352.22	741.83	0.89	3284.15	210.62
Sample 2					
World price	0.61	0.43	0.07	2.55	70.47
Log of error-term	-0.01	0.10	-0.30	0.29	-1968.31
Domestic prevailing price	0.61	0.42	0.07	2.40	69.24
Expected world price	0.62	0.43	0.07	2.56	70.21
Expected domestic price	0.62	0.43	0.07	2.43	69.39
Sample 3					
World price	2.45	2.61	0.33	14.99	106.32
Log of error-term	0.00	0.10	-0.30	0.26	1979.93
Domestic prevailing price	2.40	2.47	0.33	14.43	103.28
Expected world price	2.44	2.59	0.33	15.06	106.06
Expected domestic price	2.41	2.52	0.33	15.03	104.35
Sample 4					
World price	4.78	2.79	0.57	13.11	58.39
Log of error-term	0.00	0.10	-0.28	0.28	3755.64
Domestic prevailing price	4.73	2.72	0.58	12.49	57.55
Expected world price	4.80	2.81	0.57	13.17	58.56
Expected domestic price	4.76	2.76	0.57	12.56	58.03
Sample 5					
World price	7.50	3.85	0.98	19.37	51.36
Log of error-term	0.00	0.10	-0.32	0.28	3361.79
Domestic prevailing price	7.47	3.80	1.04	19.37	50.90
Expected world price	7.53	3.88	0.99	19.47	51.53
Expected domestic price	7.50	3.84	1.01	19.47	51.20
Sample 6					
World price	0.42	0.51	0.01	1.88	122.31
Log of error-term	-0.01	0.10	-0.34	0.34	-1329.12
Domestic prevailing price	0.42	0.51	0.01	1.79	120.90
Expected world price	0.42	0.51	0.01	1.89	121.82
Expected domestic price	0.42	0.51	0.01	1.87	121.08
Sample 7					
World price	0.10	0.16	0.00	1.04	168.40
Log of error-term	-0.01	0.10	-0.31	0.24	-685.34
Domestic prevailing price	0.10	0.17	0.00	1.04	169.43
Expected world price	0.10	0.17	0.00	1.05	169.87
Expected domestic price	0.10	0.17	0.00	1.05	170.50
Sample 8					
World price	3.10	2.68	0.68	15.59	86.48
Log of error-term	0.00	0.11	-0.33	0.28	16711.74
Domestic prevailing price	3.07	2.60	0.71	15.42	84.64
Expected world price	3.12	2.70	0.68	15.67	86.51
Expected domestic price	3.09	2.64	0.68	15.49	85.26
Sample 9					
World price	22.81	23.91	1.01	107.66	104.81
Log of error-term	0.01	0.10	-0.30	0.33	1184.68
Domestic prevailing price	22.45	23.40	1.01	104.50	104.20
Expected world price	22.78	23.94	1.01	108.20	105.09
Expected domestic price	22.55	23.60	1.01	107.11	104.67
Sample 10					
World price	0.45	0.58	0.05	2.68	126.95
Log of error-term	-0.00	0.10	-0.30	0.32	-2621.64
Domestic prevailing price	0.46	0.57	0.06	2.63	125.30
Expected world price	0.46	0.58	0.05	2.70	126.56
Expected domestic price	0.46	0.57	0.06	2.64	125.39

Annex I: Simulation results for key variables

Table 4: Exporter case - producer income, and changes in producer, consumer, and government welfare.

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 1						
Consumer welfare change	-1.05	-37.54	26.90	-682.81	-1.24	5.34
Producer welfare change, exclusive of risk benefit	2.85	-103.97	247.45	1149.43	2.76	18.08
Government welfare change, without hedging	-2.92	-268.91	121.02	-1231.45	-2.89	19.61
Government welfare change, with hedging	-0.10	-260.60	121.02	-30968.31	-3.08	27.36
Standard efficiency loss	-1.12	-74.20	45.49	-984.96	-1.87	12.64
Producer income without stabilization program	426.46	22.05	1637.03	74.89	0.73	0.01
Producer income with stabilization	430.73	23.63	1610.87	73.79	0.67	-0.19
Sample 2						
Consumer welfare change	0.62	-70.04	43.31	1753.72	-0.89	8.20
Producer welfare change, exclusive of risk benefit	-73.04	-10031.71	6308.93	-1559.36	-0.96	20.99
Government welfare change, without hedging	70.84	-7969.58	12086.44	1972.33	0.43	21.11
Government welfare change, with hedging	149.25	-7709.63	12086.44	838.30	1.60	27.29
Standard efficiency loss	-1.59	-2263.03	2280.62	-21886.25	-0.94	17.95
Producer income without stabilization program	10159.25	238.34	56482.20	118.29	1.40	1.39
Producer income with stabilization	10049.69	267.40	53130.25	116.78	1.30	0.85
Sample 3						
Consumer welfare change	-0.06	-30.22	39.87	-13470.45	0.40	4.39
Producer welfare change, exclusive of risk benefit	-1.93	-728.12	1041.31	-6558.21	2.29	29.65
Government welfare change, without hedging	0.54	-1255.18	1057.07	29085.34	-2.06	33.76
Government welfare change, with hedging	8.39	-1130.87	1057.07	1656.43	-0.70	33.89
Standard efficiency loss	-1.45	-404.25	345.57	-3020.99	-0.18	35.36
Producer income without stabilization program	1095.49	127.34	11014.94	131.94	3.85	17.26
Producer income with stabilization	1092.59	137.66	10349.14	130.74	3.71	15.71
Sample 4						
Consumer welfare change	0.50	-45.99	59.45	2521.03	0.48	4.01
Producer welfare change, exclusive of risk benefit	-173.86	-19857.04	7364.79	-1186.66	-3.40	27.31
Government welfare change, without hedging	157.41	-11006.02	22910.23	1551.78	2.66	25.26
Government welfare change, with hedging	311.16	-5933.24	22908.96	702.14	4.54	35.13
Standard efficiency loss	-15.94	-3687.22	3349.89	-3671.08	-0.49	17.19
Producer income without stabilization program	17812.26	816.62	87683.69	91.44	1.13	1.01
Producer income with stabilization	17551.48	856.95	71285.44	88.80	0.94	0.06
Sample 5						
Consumer welfare change	-0.40	-29.12	29.30	-1732.98	-0.11	3.71
Producer welfare change, exclusive of risk benefit	0.75	-428.25	337.86	5868.89	-0.88	38.97
Government welfare change, without hedging	-1.26	-421.31	499.87	-3917.62	0.44	43.84
Government welfare change, with hedging	1.05	-354.59	499.86	4247.18	1.96	54.45
Standard efficiency loss	-0.92	-112.58	98.17	-1390.04	-1.13	28.83
Producer income without stabilization program	281.29	5.19	2737.81	161.83	2.75	8.36
Producer income with stabilization	282.41	5.83	2606.75	158.85	2.59	7.00
Sample 6						
Consumer welfare change	-0.58	-25.38	25.47	-969.13	-0.66	4.75
Producer welfare change, exclusive of risk benefit	-0.37	-276.82	166.74	-7642.11	-3.02	34.27
Government welfare change, without hedging	0.41	-204.33	388.45	8095.34	4.12	53.27
Government welfare change, with hedging	2.20	-161.09	388.45	1367.50	5.99	71.09
Standard efficiency loss	-0.55	-60.59	135.82	-2025.50	4.27	58.67
Producer income without stabilization program	343.91	24.39	2746.40	152.43	2.59	6.19
Producer income with stabilization	343.35	27.19	2484.72	149.67	2.51	5.72

Annex I: Simulation results for key variables

Table 4: Exporter case - producer income, and changes in producer, consumer and government welfare (continued.)

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 7						
Consumer welfare change	0.19	-34.93	40.96	4761.71	0.43	4.00
Producer welfare change, exclusive of risk benefit	-15.30	-1734.57	1530.74	-1594.75	-1.25	17.27
Government welfare change, without hedging	13.22	-1934.72	2111.88	2274.84	1.17	18.38
Government welfare change, with hedging	32.75	-1533.18	2111.86	825.50	2.49	22.51
Standard efficiency loss	-1.88	-424.58	414.06	-4228.72	0.63	15.19
Producer income without stabilization program	2590.90	230.74	20717.94	131.39	2.55	6.91
Producer income with stabilization	2567.95	234.79	19138.73	129.79	2.46	6.26
Sample 8						
Consumer welfare change	-0.08	-29.45	28.47	-8474.01	-0.33	3.75
Producer welfare change, exclusive of risk benefit	-3.12	-471.54	183.60	-1782.32	-2.32	18.66
Government welfare change, without hedging	2.52	-253.94	519.61	2488.39	2.03	18.00
Government welfare change, with hedging	7.54	-175.37	519.61	736.07	3.56	26.50
Standard efficiency loss	-0.68	-101.39	110.47	-2628.46	-0.29	9.91
Producer income without stabilization program	774.78	156.39	3172.62	66.97	1.42	2.17
Producer income with stabilization	770.10	156.39	2649.53	65.17	1.32	1.61
Sample 9						
Consumer welfare change	1.17	-51.94	39.88	857.01	-0.02	3.45
Producer welfare change, exclusive of risk benefit	-172.30	-19794.57	6865.05	-702.95	-9.17	145.52
Government welfare change, without hedging	188.86	-10280.62	25211.99	827.66	9.04	144.18
Government welfare change, with hedging	247.13	-3670.27	25211.99	593.02	11.63	180.26
Standard efficiency loss	17.72	-5523.76	5456.61	2820.39	0.75	73.05
Producer income without stabilization program	13358.01	547.77	140765.67	166.96	3.09	10.44
Producer income with stabilization	13099.56	686.10	129189.81	166.25	3.04	9.84
Sample 10						
Consumer welfare change	1.65	-40.77	48.83	714.82	0.47	2.91
Producer welfare change, exclusive of risk benefit	-418.39	-31194.66	28785.50	-875.09	-1.96	32.53
Government welfare change, without hedging	480.49	-37243.66	37628.99	935.07	1.45	31.87
Government welfare change, with hedging	643.13	-31908.77	37628.57	643.75	2.88	35.54
Standard efficiency loss	63.75	-8498.79	12081.40	1927.27	2.29	35.47
Producer income without stabilization program	34118.45	451.85	278736.66	171.84	2.21	3.97
Producer income with stabilization	33490.87	487.53	260537.65	171.51	2.17	3.62

Annex I: Simulation results for key variables

Table 5: Importer case - summary statistics on simulation price variables.

Sample	Mean	Std Dev	Minimum	Maximum	% C.V.
Sample 1					
Log of error-term	0.00	0.10	-0.31	0.30	2944.13
World price	4.35	4.11	0.84	21.96	94.41
Domestic prevailing price	4.31	4.02	0.89	18.80	93.26
Expected world price	4.37	4.13	0.85	22.07	94.66
Expected domestic price	4.33	4.06	0.86	20.15	93.72
Sample 2					
Log of error-term	-0.00	0.10	-0.27	0.37	-9646.42
World price	1.15	0.76	0.29	3.64	66.02
Domestic prevailing price	1.15	0.74	0.30	3.11	64.78
Expected world price	1.16	0.76	0.29	3.66	65.94
Expected domestic price	1.16	0.75	0.30	3.38	65.15
Sample 3					
Log of error-term	0.00	0.10	-0.28	0.38	5735.61
World price	2.77	1.55	0.50	8.69	55.93
Domestic prevailing price	2.75	1.50	0.50	8.36	54.50
Expected world price	2.78	1.56	0.51	8.73	56.06
Expected domestic price	2.76	1.53	0.51	8.72	55.27
Sample 4					
Log of error-term	-0.00	0.10	-0.27	0.34	-6038.67
World price	0.54	0.22	0.20	1.28	41.12
Domestic prevailing price	0.53	0.22	0.24	1.23	40.27
Expected world price	0.54	0.22	0.20	1.29	41.22
Expected domestic price	0.54	0.22	0.23	1.26	40.69
Sample 5					
Log of error-term	-0.00	0.10	-0.38	0.25	-3011.23
World price	1.22	0.78	0.16	3.79	63.67
Domestic prevailing price	1.22	0.76	0.17	3.47	62.44
Expected world price	1.23	0.78	0.16	3.81	63.48
Expected domestic price	1.22	0.77	0.16	3.60	62.77
Sample 6					
Log of error-term	0.00	0.10	-0.31	0.30	2947.89
World price	1.60	1.96	0.21	8.33	122.95
Domestic prevailing price	1.58	1.94	0.22	7.56	122.92
Expected world price	1.60	1.97	0.21	8.38	123.21
Expected domestic price	1.59	1.96	0.22	7.92	123.24
Sample 7					
Log of error-term	0.01	0.10	-0.26	0.35	675.96
World price	173.90	351.31	0.25	1452.39	202.02
Domestic prevailing price	169.87	344.70	0.26	1373.51	202.92
Expected world price	172.13	349.38	0.25	1459.67	202.98
Expected domestic price	169.60	344.75	0.26	1394.71	203.27
Sample 8					
Log of error-term	-0.00	0.10	-0.37	0.26	-31288.43
World price	1.22	0.64	0.29	3.26	52.26
Domestic prevailing price	1.21	0.62	0.33	3.08	51.34
Expected world price	1.22	0.64	0.30	3.27	52.23
Expected domestic price	1.22	0.63	0.32	3.19	51.73
Sample 9					
Log of error-term	0.00	0.11	-0.36	0.32	2973.01
World price	2.25	1.59	0.28	6.64	70.57
Domestic prevailing price	2.22	1.56	0.28	6.38	70.04
Expected world price	2.25	1.59	0.28	6.67	70.55
Expected domestic price	2.23	1.57	0.28	6.51	70.33
Sample 10					
Log of error-term	0.00	0.09	-0.28	0.30	4293.05
World price	0.67	0.87	0.05	4.45	130.24
Domestic prevailing price	0.66	0.85	0.05	4.26	128.62
Expected world price	0.67	0.87	0.05	4.47	130.11
Expected domestic price	0.66	0.86	0.05	4.44	129.29

Annex I: Simulation results for key variables

Table 6: Importer Case - producer income, and changes in producer, consumer, and government welfare.

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 1						
Consumer welfare change	9.82	-367.15	561.71	1075.72	0.66	4.08
Producer welfare change, exclusive of risk benefit	-12.23	-1390.69	444.43	-1245.32	-4.15	31.75
Government welfare change, without hedging	-1.50	-421.39	1128.23	-8369.79	3.63	30.63
Government welfare change, with hedging	5.16	-277.57	1128.23	2201.93	5.42	44.75
Standard efficiency loss	-3.91	-257.35	299.25	-1153.46	0.10	16.28
Producer income without stabilization program	1173.08	79.35	9928.83	142.40	2.34	5.68
Producer income with stabilization program	1154.74	85.29	8294.76	139.91	2.22	4.80
Sample 2						
Consumer welfare change	-2.07	-470.01	313.04	-4204.89	-0.62	5.39
Producer welfare change, exclusive of risk benefit	-0.61	-97.41	93.77	-2199.22	-0.49	22.84
Government welfare change, without hedging	-0.39	-289.02	292.10	-18714.25	-0.09	3.74
Government welfare change, with hedging	-1.52	-248.30	292.10	-4488.89	0.64	3.20
Standard efficiency loss	-3.07	-89.62	12.91	-283.64	-5.04	35.41
Producer income without stabilization program	142.97	15.93	660.30	96.53	1.34	0.89
Producer income with stabilization program	142.06	16.28	549.17	94.66	1.24	0.33
Sample 3						
Consumer welfare change	2.74	-469.05	474.52	4078.44	0.04	3.40
Producer welfare change, exclusive of risk benefit	-3.39	-331.77	337.00	-1709.21	-0.81	13.53
Government welfare change, without hedging	-3.88	-338.79	236.63	-1638.97	-0.91	5.46
Government welfare change, with hedging	-3.49	-262.54	236.63	-1606.76	0.12	3.49
Standard efficiency loss	-4.53	-127.36	65.41	-399.25	-2.71	14.99
Producer income without stabilization program	510.16	36.48	2563.80	86.96	1.96	4.07
Producer income with stabilization program	505.08	36.48	2469.20	84.77	1.86	3.60
Sample 4						
Consumer welfare change	-0.92	-238.48	242.17	-6726.64	0.08	2.54
Producer welfare change, exclusive of risk benefit	-0.09	-14.19	9.58	-2861.11	-0.80	6.90
Government welfare change, without hedging	-0.79	-258.37	204.92	-7540.93	-0.46	2.80
Government welfare change, with hedging	-0.62	-172.64	204.92	-8564.85	0.49	1.65
Standard efficiency loss	-1.81	-26.82	0.91	-211.28	-3.26	13.05
Producer income without stabilization program	41.60	10.07	143.17	64.28	1.60	2.11
Producer income with stabilization program	41.46	11.63	135.92	63.29	1.55	1.75
Sample 5						
Consumer welfare change	-4.03	-267.10	282.71	-1806.58	0.03	2.66
Producer welfare change, exclusive of risk benefit	-0.61	-69.74	67.63	-2019.56	-0.93	12.21
Government welfare change, without hedging	2.52	-245.00	189.90	2411.53	-0.22	2.62
Government welfare change, with hedging	2.03	-163.96	189.90	2724.87	0.64	1.47
Standard efficiency loss	-2.12	-47.15	14.76	-266.99	-2.73	11.95
Producer income without stabilization program	154.32	6.33	666.66	91.19	1.35	1.26
Producer income with stabilization program	153.41	6.74	613.76	89.83	1.31	1.07
Sample 6						
Consumer welfare change	7.88	-376.98	369.53	1058.58	0.33	3.71
Producer welfare change, exclusive of risk benefit	-2.52	-218.96	282.65	-1336.71	0.47	27.95
Government welfare change, without hedging	-7.92	-320.77	223.58	-846.19	-1.05	4.49
Government welfare change, with hedging	-5.53	-207.80	223.58	-1008.41	0.14	3.13
Standard efficiency loss	-2.57	-119.05	92.97	-472.25	-2.08	30.39
Producer income without stabilization program	300.47	10.45	2221.47	164.70	1.82	2.27
Producer income with stabilization program	296.69	11.0[illegible]	2078.16	164.71	1.79	2.03

Annex I: Simulation results for key variables

Table 6: Importer case - producer income, and changes in producer, consumer and government welfare (continued.)

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 7						
Consumer welfare change	43.69	-564.84	1239.40	403.55	2.41	13.00
Producer welfare change, exclusive of risk benefit	-8668.51	-704522.54	389859.57	-858.97	-4.49	40.57
Government welfare change, without hedging	9304.13	-538014.60	794703.87	975.17	4.04	38.13
Government welfare change, with hedging	11605.00	-401003.66	794703.87	722.10	5.99	47.50
Standard efficiency loss	679.32	-179546.54	265109.14	3735.27	2.19	46.68
Producer income without stabilization program	489856.07	12.66	5336175.56	239.36	2.43	4.53
Producer income with stabilization program	476853.31	13.20	5129486.15	240.43	2.42	4.32
Sample 8						
Consumer welfare change	-0.84	-277.78	326.98	-9015.14	0.04	3.43
Producer welfare change, exclusive of risk benefit	-0.36	-73.67	47.23	-2842.60	-1.47	14.76
Government welfare change, without hedging	-1.13	-292.64	207.32	-5839.17	-0.46	3.73
Government welfare change, with hedging	-1.70	-186.39	207.32	-3491.05	0.54	2.36
Standard efficiency loss	-2.33	-41.60	13.56	-271.09	-2.69	9.11
Producer income without stabilization program	147.43	16.24	537.04	76.72	1.22	1.17
Producer income with stabilization program	146.89	18.82	513.77	75.59	1.17	0.96
Sample 9						
Consumer welfare change	9.84	-370.93	484.66	1016.77	0.70	4.68
Producer welfare change, exclusive of risk benefit	-4.25	-168.91	127.90	-681.70	-1.53	9.45
Government welfare change, without hedging	-9.07	-460.74	269.40	-872.79	-1.64	7.48
Government welfare change, with hedging	-7.01	-282.58	269.40	-926.28	-0.23	3.99
Standard efficiency loss	-3.48	-82.95	58.28	-357.72	-2.33	12.03
Producer income without stabilization program	398.89	15.11	1701.62	95.05	1.05	0.54
Producer income with stabilization program	392.51	15.11	1557.42	94.45	1.02	0.43
Sample 10						
Consumer welfare change	5.30	-216.14	444.15	1246.61	1.05	6.64
Producer welfare change, exclusive of risk benefit	-1.54	-146.43	21.24	-709.91	-8.87	97.26
Government welfare change, without hedging	-5.66	-348.76	189.58	-1073.04	-0.95	4.66
Government welfare change, with hedging	-4.98	-213.15	189.58	-1054.75	0.19	2.28
Standard efficiency loss	-1.90	-51.04	21.07	-261.97	-3.84	26.35
Producer income without stabilization program	82.73	1.30	934.41	195.36	3.08	9.75
Producer income with stabilization program	80.41	1.36	891.09	194.27	3.12	10.12

Annex I: Simulation results for key variables

Table 7: Wide band case - summary statistics on simulation price variables.

Sample	Mean	Std Dev	Minimum	Maximum	% C.V.
Sample 1					
Log of error-term	0.00	0.10	-0.28	0.34	3021.86
World price	7.43	5.16	0.77	22.40	69.44
Domestic prevailing price	7.42	5.14	0.80	22.40	69.25
Expected world price	7.46	5.19	0.78	22.52	69.62
Expected domestic price	7.46	5.19	0.78	22.52	69.60
Sample 2					
Log of error-term	-0.00	0.10	-0.33	0.32	-28236.99
World price	4.53	4.14	0.80	18.69	91.33
Domestic prevailing price	4.51	4.11	0.81	17.66	91.23
Expected world price	4.55	4.16	0.81	18.78	91.32
Expected domestic price	4.55	4.15	0.81	18.78	91.34
Sample 3					
Log of error-term	0.01	0.10	-0.26	0.34	1739.47
World price	11.86	6.88	0.96	39.37	57.97
Domestic prevailing price	11.78	6.76	0.96	38.05	57.37
Expected world price	11.89	6.92	0.97	39.57	58.24
Expected domestic price	11.86	6.89	0.97	38.24	58.07
Sample 4					
Log of error-term	-0.00	0.10	-0.34	0.27	-68173.18
World price	0.70	0.34	0.16	2.49	48.58
Domestic prevailing price	0.70	0.33	0.16	2.17	47.78
Expected world price	0.71	0.34	0.16	2.50	48.58
Expected domestic price	0.71	0.34	0.16	2.38	48.40
Sample 5					
Log of error-term	0.01	0.10	-0.30	0.31	1153.70
World price	15.89	21.05	0.80	116.13	132.53
Domestic prevailing price	15.79	20.86	0.80	107.29	132.12
Expected world price	15.81	20.99	0.80	116.72	132.75
Expected domestic price	15.79	20.93	0.80	114.62	132.58
Sample 6					
Log of error-term	-0.00	0.10	-0.28	0.28	-11864.24
World price	1.82	1.41	0.37	8.13	77.52
Domestic prevailing price	1.81	1.39	0.40	7.34	76.92
Expected world price	1.83	1.42	0.38	8.17	77.46
Expected domestic price	1.83	1.41	0.38	7.92	77.30
Sample 7					
Log of error-term	0.00	0.10	-0.31	0.24	2643.63
World price	2.13	2.54	0.30	10.77	118.99
Domestic prevailing price	2.12	2.52	0.31	10.64	118.82
Expected world price	2.13	2.54	0.31	10.83	119.26
Expected domestic price	2.13	2.54	0.31	10.83	119.27
Sample 8					
Log of error-term	0.00	0.10	-0.31	0.27	9486.80
World price	1.06	0.45	0.31	2.77	42.48
Domestic prevailing price	1.05	0.44	0.31	2.77	41.75
Expected world price	1.06	0.45	0.32	2.79	42.46
Expected domestic price	1.06	0.45	0.32	2.79	42.15
Sample 9					
Log of error-term	0.00	0.10	-0.28	0.33	2629.23
World price	2.28	1.60	0.76	8.79	70.39
Domestic prevailing price	2.27	1.59	0.76	8.29	70.05
Expected world price	2.28	1.60	0.76	8.83	70.29
Expected domestic price	2.28	1.60	0.76	8.42	70.08
Sample 10					
Log of error-term	0.00	0.10	-0.29	0.33	6927.83
World price	1.07	1.08	0.12	4.25	101.12
Domestic prevailing price	1.07	1.07	0.12	4.20	100.87
Expected world price	1.07	1.09	0.12	4.28	101.24
Expected domestic price	1.07	1.08	0.12	4.28	101.26

Annex I: Simulation results for key variables

Table 8: Wide band Case - producer income, and changes in producer, consumer, and government welfare.

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 1						
Consumer welfare change	0.32	-31.44	34.76	1873.06	0.19	13.06
Producer welfare change, without hedging	-2.75	-737.50	411.57	-2928.31	-1.77	27.22
Government welfare change, without hedging	3.01	-592.26	951.95	3484.88	1.54	26.92
Government welfare change, with hedging	9.18	-366.95	951.95	961.31	4.68	42.03
Standard efficiency loss	0.57	-207.48	249.21	5699.90	0.88	24.26
Producer income without stabilization program	2392.68	71.02	10004.20	92.47	0.94	0.25
Producer income with stabilization program	2388.55	74.01	10004.20	92.15	0.92	0.21
Sample 2						
Consumer welfare change	0.45	-22.37	36.31	1007.90	2.30	18.96
Producer welfare char), without hedging	-4.47	-295.87	167.49	-859.68	-4.27	29.59
Government welfare change, without hedging	5.28	-230.20	426.40	942.29	4.61	36.32
Government welfare change, with hedging	7.05	-118.07	426.40	656.75	6.25	45.76
Standard efficiency loss	1.27	-85.08	147.25	1279.43	4.50	40.08
Producer income without stabilization program	1237.96	75.51	7759.41	130.68	1.77	2.57
Producer income with stabilization program	1231.26	75.79	7331.43	130.74	1.77	2.54
Sample 3						
Consumer welfare change	0.80	-25.38	35.79	679.74	2.01	14.88
Producer welfare change, without hedging	-24.13	-2240.97	686.47	-713.68	-6.11	66.74
Government welfare change, without hedging	30.54	-1012.04	3292.61	799.66	6.60	76.08
Government welfare change, with hedging	38.19	-495.57	3292.61	598.73	8.51	96.29
Standard efficiency loss	7.20	-381.61	1083.95	1154.83	5.70	68.16
Producer income without stabilization program	4581.33	96.20	23159.69	85.54	1.89	4.80
Producer income with stabilization program	4545.13	96.20	22587.27	84.68	1.83	4.52
Sample 4						
Consumer welfare change	0.25	-12.72	20.60	986.85	2.67	23.70
Producer welfare change, without hedging	-0.24	-30.31	4.92	-784.49	-10.02	135.45
Government welfare change, without hedging	0.05	-16.42	28.52	3972.02	4.26	101.19
Government welfare change, with hedging	0.03	-9.32	28.52	6942.31	6.95	115.53
Standard efficiency loss	0.06	-5.17	14.25	1581.40	9.42	150.60
Producer income without stabilization program	63.93	6.72	358.85	75.46	2.29	8.03
Producer income with stabilization program	63.56	6.74	315.63	74.12	2.15	6.98
Sample 5						
Consumer welfare change	0.84	-34.14	33.98	691.37	0.53	12.42
Producer welfare change, without hedging	-48.47	-7750.55	1546.08	-970.86	-11.94	169.34
Government welfare change, without hedging	62.15	-2311.94	11597.60	1086.47	12.85	195.18
Government welfare change, with hedging	69.76	-921.71	11597.60	951.44	13.59	208.22
Standard efficiency loss	14.51	-773.13	3874.10	1557.70	12.49	194.25
Producer income without stabilization program	9689.23	73.91	116025.40	192.29	2.79	8.17
Producer income with stabilization program	9616.52	73.91	114863.83	191.50	2.74	7.67
Sample 6						
Consumer welfare change	0.37	-21.21	28.29	976.57	1.63	18.24
Producer welfare change, without hedging	-1.65	-151.13	18.26	-671.35	-8.85	97.78
Government welfare change, without hedging	1.74	-20.09	208.76	778.28	10.68	136.47
Government welfare change, with hedging	1.79	-15.69	208.76	755.27	10.80	138.42
Standard efficiency loss	0.46	-24.04	74.76	1125.57	8.21	102.61
Producer income without stabilization program	295.51	24.81	2105.47	121.47	2.23	4.92
Producer income with stabilization program	293.04	26.47	2066.58	120.86	2.20	4.66

Annex I: Simulation results for key variables

Table 8: Wide band case - producer income, and changes in producer, consumer and government welfare (continued.)

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 7						
Consumer welfare change	0.38	-20.03	22.86	895.62	1.54	19.19
Producer welfare change, without hedging	-1.64	-153.45	92.38	-874.96	-6.93	70.04
Government welfare change, without hedging	1.76	-128.55	214.18	1066.15	7.26	79.99
Government welfare change, with hedging	2.08	-6.98	214.18	850.91	9.47	95.35
Standard efficiency loss	0.51	-46.47	76.09	1284.77	7.23	85.79
Producer income without stabilization program	449.91	17.22	3500.25	169.22	2.07	3.27
Producer income with stabilization program	447.46	17.22	3500.25	169.10	2.07	3.26
Sample 8						
Consumer welfare change	0.33	-28.83	26.28	1284.63	0.71	16.59
Producer welfare change, without hedging	-0.60	-33.98	21.85	-739.90	-3.83	26.88
Government welfare change, without hedging	0.31	-9.66	31.45	790.83	5.23	64.23
Government welfare change, with hedging	0.35	-6.71	31.45	673.23	7.07	72.41
Standard efficiency loss	0.06	-11.72	15.66	2942.58	1.41	25.99
Producer income without stabilization program	115.88	19.17	429.80	64.40	1.53	2.88
Producer income with stabilization program	114.98	19.17	429.80	63.73	1.56	3.10
Sample 9						
Consumer welfare change	0.33	-34.36	20.10	1356.88	-1.49	20.32
Producer welfare change, without hedging	-1.14	-182.07	109.56	-1348.54	-3.51	62.39
Government welfare change, without hedging	1.10	-149.37	251.90	1681.45	5.96	102.76
Government welfare change, with hedging	1.63	-74.79	251.90	1009.55	10.28	145.64
Standard efficiency loss	0.29	-55.45	89.93	2450.37	4.21	82.17
Producer income without stabilization program	399.43	70.99	2490.55	113.65	2.32	5.12
Producer income with stabilization program	397.72	70.99	2387.23	113.14	2.28	4.87
Sample 10						
Consumer welfare change	0.32	-12.33	20.51	953.50	2.00	13.40
Producer welfare change, without hedging	-0.38	-44.10	29.26	-1203.05	-5.03	51.28
Government welfare change, without hedging	0.14	-34.21	52.74	3965.71	4.04	44.73
Government welfare change, with hedging	0.30	-19.94	52.74	1607.76	6.65	61.63
Standard efficiency loss	0.07	-14.94	21.52	2652.96	4.94	66.40
Producer income without stabilization program	148.84	4.45	849.74	139.41	1.64	1.63
Producer income with stabilization program	148.26	4.45	849.74	139.05	1.62	1.56

Annex I: Simulation results for key variables

Table 9: Upward drift case - summary statistics on simulation price variables.

Sample	Mean	Std Dev	Minimum	Maximum	% C.V.
Sample 1					
Log of error-term	-0.00	0.10	-0.34	0.29	-3450.45
World price	53.89	51.07	1.06	203.84	94.76
domestic prevailing price	53.09	50.03	1.06	190.90	94.24
Expected world price	54.07	51.23	1.01	205.36	94.75
Expected domestic price	53.50	50.58	1.01	196.88	94.53
Sample 2					
Log of error-term	0.01	0.10	-0.30	0.30	993.58
World price	229.05	295.41	1.06	1548.24	128.97
domestic prevailing price	224.65	287.38	1.06	1490.64	127.92
Expected world price	227.45	291.70	1.01	1556.50	128.25
Expected domestic price	225.00	287.66	1.01	1476.75	127.80
Sample 3					
Log of error-term	-0.00	0.10	-0.33	0.30	-3459.94
World price	22.49	13.70	1.03	78.58	60.92
domestic prevailing price	22.18	13.17	1.03	77.35	59.40
Expected world price	22.70	13.70	1.01	79.47	60.34
Expected domestic price	22.44	13.37	1.01	77.03	59.59
Sample 4					
Log of error-term	0.01	0.10	-0.27	0.31	985.34
World price	263.76	408.68	0.93	2480.72	154.94
domestic prevailing price	255.40	386.55	0.94	2288.12	151.35
Expected world price	260.35	398.68	0.94	2366.12	153.13
Expected domestic price	256.02	387.42	0.94	2288.12	151.32
Sample 5					
Log of error-term	0.00	0.09	-0.26	0.29	5329.99
World price	69.04	65.21	1.08	226.73	94.45
domestic prevailing price	68.33	64.33	1.08	216.21	94.15
Expected world price	69.43	65.71	1.01	228.34	94.64
Expected domestic price	68.87	65.08	1.01	225.59	94.49
Sample 6					
Log of error-term	0.00	0.10	-0.31	0.26	2056.32
World price	112.57	157.28	1.02	723.54	139.72
domestic prevailing price	110.88	154.54	1.06	723.54	139.37
Expected world price	112.36	157.25	1.01	727.65	139.95
Expected domestic price	111.26	155.49	1.01	727.65	139.76
Sample 7					
Log of error-term	0.01	0.10	-0.32	0.27	830.23
World price	306.18	298.26	0.78	1344.49	97.41
domestic prevailing price	300.90	290.73	0.85	1315.89	96.62
Expected world price	305.27	296.53	0.79	1336.95	97.14
Expected domestic price	301.88	291.73	0.85	1314.09	96.64
Sample 8					
Log of error-term	0.00	0.10	-0.28	0.32	3467.66
World price	81.61	70.10	0.79	274.55	85.90
domestic prevailing price	80.87	69.50	0.87	262.96	85.94
Expected world price	82.02	70.64	0.81	276.34	86.13
Expected domestic price	81.44	70.16	0.88	271.73	86.15
Sample 9					
Log of error-term	0.00	0.10	-0.34	0.30	3024.95
World price	62.11	42.55	1.25	224.81	68.50
domestic prevailing price	61.40	41.69	1.10	213.97	67.90
Expected world price	62.48	42.93	1.01	226.30	68.71
Expected domestic price	61.90	42.26	1.01	215.40	68.28
Sample 10					
Log of error-term	0.00	0.10	-0.29	0.31	5975.75
World price	91.30	80.51	0.64	321.12	88.18
domestic prevailing price	90.76	79.88	0.68	298.94	88.02
Expected world price	91.75	81.11	0.65	323.15	88.40
Expected domestic price	91.36	80.74	0.67	308.36	88.38

Annex I: Simulation results for key variables

Table 10: Upward drift Case - producer income, and changes in producer, consumer, and government welfare.

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 1						
Consumer welfare change	2.91	-72.63	57.70	549.00	0.01	3.21
Producer welfare change, exclusive of risk benefit	-709.33	-29359.30	13829.43	-568.46	-2.26	12.78
Government welfare change, without hedging	754.42	-19265.29	33442.54	667.59	2.06	12.22
Government welfare change, with hedging	1040.12	-14948.92	33442.38	442.43	3.13	15.84
Standard efficiency loss	47.99	-7514.15	10233.77	2811.89	0.85	12.50
Producer income without stabilization program	52680.33	106.49	279370.00	121.32	1.57	2.04
Producer income with stabilization program	51616.33	106.49	259323.57	120.52	1.54	1.92
Sample 2						
Consumer welfare change	19.31	-631.55	958.76	639.17	1.78	17.11
Producer welfare change, exclusive of risk benefit	-9032.26	-557233.00	267813.58	-599.46	-3.06	29.73
Government welfare change, without hedging	10456.47	-337959.19	706034.86	667.17	3.15	29.26
Government welfare change, with hedging	12892.16	-279355.26	706034.30	509.48	4.17	35.02
Standard efficiency loss	1443.51	-111211.43	149760.62	1390.64	2.13	18.25
Producer income without stabilization program	528729.37	112.04	5831870.86	577..	2.67	8.31
Producer income with stabilization program	515180.98	110.33	5728318.56	174.86	2.55	7.27
Sample 3						
Consumer welfare change	2.28	-53.44	73.17	656.51	0.73	4.35
Producer welfare change, exclusive of risk benefit	-177.09	-7439.64	6588.26	-687.82	-2.00	14.77
Government welfare change, without hedging	173.57	-8273.69	9125.34	844.61	1.82	15.20
Government welfare change, with hedging	264.81	-7328.84	9124.70	511.15	2.66	18.77
Standard efficiency loss	-1.23	-1882.15	2756.27	-29688.01	1.22	14.99
Producer income without stabilization program	12159.00	103.19	67884.96	87.20	1.93	5.73
Producer income with stabilization program	11893.37	103.19	67884.96	84.28	1.73	4.82
Sample 4						
Consumer welfare change	41.76	-954.34	2435.36	556.47	4.26	33.19
Producer welfare change, exclusive of risk benefit	-23362.84	-1571033.07	548514.56	-609.94	-5.69	48.33
Government welfare change, without hedging	26902.92	-752745.16	1844705.39	631.75	5.30	43.48
Government welfare change, with hedging	29946.81	-525010.16	1844704.50	551.35	5.96	47.71
Standard efficiency loss	3581.84	-205184.94	343512.10	1067.31	3.99	37.09
Producer income without stabilization program	725794.22	97.06	12066912.61	220.19	3.77	16.81
Producer income with stabilization program	690749.95	98.97	10945078.73	213.22	3.54	14.61
Sample 5						
Consumer welfare change	2.36	-56.62	84.01	659.90	0.51	4.55
Producer welfare change, exclusive of risk benefit	-701.35	-59374.73	27454.08	-891.05	-2.70	22.94
Government welfare change, without hedging	701.13	-37426.38	68770.34	1096.33	2.16	20.10
Government welfare change, with hedging	1174.45	-25758.64	68770.06	589.82	3.59	27.39
Standard efficiency loss	2.15	-11784.42	10471.17	92862.70	0.34	10.61
Producer income without stabilization program	76588.79	108.64	335890.47	115.14	0.90	-0.49
Producer income with stabilization program	75536.77	108.64	317919.14	114.57	0.87	-0.59
Sample 6						
Consumer welfare change	7.46	-272.17	536.59	796.37	5.36	46.80
Producer welfare change, exclusive of risk benefit	-2516.49	-229399.41	81810.88	-876.61	-6.13	52.96
Government welfare change, without hedging	2729.00	-107303.26	247812.88	958.07	5.39	46.34
Government welfare change, with hedging	3674.13	-80495.96	247812.84	666.53	6.96	57.98
Standard efficiency loss	219.97	-30159.43	75009.27	2774.42	4.54	63.84
Producer income without stabilization program	190869.31	107.04	1888154.12	195.47	2.71	6.99
Producer income with stabilization program	187094.57	110.33	1888154.12	194.98	2.71	7.03

Annex I: Simulation results for key variables

Table 10: Upward drift case - producer income, and changes in producer, consumer and government welfare (continued.)

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 7						
Consumer welfare change	25.04	-556.22	1067.51	601.33	2.92	16.88
Producer welfare change, exclusive of risk benefit	-11368.80	-549824.51	233310.81	-589.02	-3.62	23.03
Government welfare change, without hedging	12306.76	-308689.47	618424.67	664.74	3.28	20.51
Government welfare change, with hedging	16114.38	-228182.86	618345.49	474.47	4.30	25.47
Standard efficiency loss	963.00	-105585.28	153122.81	2219.61	1.61	17.14
Producer income without stabilization program	713222.11	72.64	4720151.93	130.90	1.83	3.25
Producer income with stabilization program	696168.91	78.69	4619862.41	129.65	1.80	3.17
Sample 8						
Consumer welfare change	2.93	-49.00	74.11	533.32	0.78	3.11
Producer welfare change, exclusive of risk benefit	-682.67	-45590.81	28520.01	-1019.10	-2.13	16.30
Government welfare change, without hedging	676.77	-42160.05	59854.99	1290.68	1.77	16.55
Government welfare change, with hedging	1268.66	-31006.28	59799.71	603.92	3.60	23.26
Standard efficiency loss	-2.97	-14067.76	19728.93	-82271.19	1.04	18.17
Producer income without stabilization program	94419.64	73.38	433914.06	107.65	1.04	0.26
Producer income with stabilization program	93395.64	81.69	415596.24	107.60	1.03	0.23
Sample 9						
Consumer welfare change	3.00	-78.80	114.29	572.54	0.55	6.11
Producer welfare change, exclusive of risk benefit	-613.78	-58561.84	26753.47	-939.14	-2.52	27.57
Government welfare change, without hedging	586.35	-35218.58	73821.71	1202.15	2.30	29.45
Government welfare change, with hedging	1016.62	-29335.09	73821.57	633.70	3.57	38.84
Standard efficiency loss	-24.43	-13280.12	15374.16	-7521.33	0.53	21.32
Producer income without stabilization program	57944.38	125.75	321875.77	90.40	1.58	4.36
Producer income with stabilization program	57023.72	110.33	313633.34	89.01	1.47	3.94
Sample 10						
Consumer welfare change	2.29	-86.27	96.63	861.65	0.34	5.16
Producer welfare change, exclusive of risk benefit	-486.73	-64411.74	74680.70	-2146.76	0.30	18.21
Government welfare change, without hedging	423.78	-98641.28	73138.79	3066.36	-0.52	17.08
Government welfare change, with hedging	1429.40	-79284.72	73136.23	791.54	0.54	20.45
Standard efficiency loss	-60.66	-27125.13	16971.28	-5559.77	-0.86	15.30
Producer income without stabilization program	113168.97	54.74	547584.81	109.41	1.14	0.70
Producer income with stabilization program	112438.88	55.77	498559.10	108.96	1.09	0.45

Annex I: Simulation results for key variables

Table 11: Deterministic model simulation - summary statistics on simulation price variables.

Sample	Mean	Std Dev	Minimum	Maximum	% C.V.
Sample 1					
Log of error-term	-0.00	0.10	-0.31	0.33	-6716.50
World price	1.01	0.13	0.65	1.46	12.85
Domestic prevailing price	1.00	0.09	0.73	1.23	8.73
Expected world price	1.00	0.05	0.86	1.15	4.75
Expected domestic price	1.00	0.05	0.85	1.15	4.85
Sample 2					
Log of error-term	0.00	0.10	-0.36	0.29	4389.88
World price	1.00	0.13	0.64	1.52	13.34
Domestic prevailing price	1.00	0.09	0.78	1.19	8.83
Expected world price	1.00	0.05	0.85	1.17	4.90
Expected domestic price	1.00	0.05	0.82	1.22	5.23
Sample 3					
Log of error-term	-0.01	0.10	-0.29	0.26	-1740.44
World price	1.02	0.13	0.70	1.54	13.07
Domestic prevailing price	1.01	0.09	0.79	1.33	8.70
Expected world price	1.01	0.05	0.88	1.18	4.78
Expected domestic price	1.01	0.05	0.88	1.18	4.90
Sample 4					
Log of error-term	0.00	0.10	-0.30	0.29	2383.63
World price	1.00	0.13	0.64	1.42	13.18
Domestic prevailing price	0.99	0.09	0.74	1.24	8.57
Expected world price	1.00	0.05	0.85	1.14	4.86
Expected domestic price	1.00	0.05	0.85	1.14	4.94
Sample 5					
Log of error-term	-0.00	0.10	-0.33	0.31	-4302.94
World price	1.01	0.13	0.62	1.46	13.24
Domestic prevailing price	1.01	0.10	0.79	1.32	9.48
Expected world price	1.00	0.05	0.84	1.15	4.90
Expected domestic price	1.00	0.05	0.84	1.15	4.99
Sample 6					
Log of error-term	0.01	0.10	-0.28	0.27	1405.42
World price	0.99	0.13	0.68	1.55	13.58
Domestic prevailing price	0.99	0.09	0.78	1.23	8.71
Expected world price	1.00	0.05	0.87	1.18	4.99
Expected domestic price	1.00	0.05	0.81	1.18	5.18
Sample 7					
Log of error-term	0.01	0.10	-0.33	0.28	1064.44
World price	0.99	0.13	0.67	1.50	13.40
Domestic prevailing price	0.98	0.09	0.73	1.34	9.51
Expected world price	1.00	0.05	0.87	1.16	4.90
Expected domestic price	1.00	0.05	0.86	1.21	5.21
Sample 8					
Log of error-term	0.00	0.10	-0.34	0.32	53401.06
World price	1.01	0.14	0.65	1.46	13.46
Domestic prevailing price	1.00	0.09	0.75	1.31	9.39
Expected world price	1.00	0.05	0.86	1.15	4.96
Expected domestic price	1.00	0.05	0.86	1.21	5.29
Sample 9					
Log of error-term	0.00	0.10	-0.31	0.30	5292.70
World price	1.00	0.14	0.63	1.51	14.07
Domestic prevailing price	1.00	0.09	0.78	1.30	9.33
Expected world price	1.00	0.05	0.84	1.17	5.17
Expected domestic price	1.00	0.05	0.85	1.17	5.38
Sample 10					
Log of error-term	0.01	0.09	-0.28	0.32	1488.45
World price	0.99	0.13	0.65	1.40	12.69
Domestic prevailing price	0.99	0.08	0.75	1.27	8.54
Expected world price	1.00	0.05	0.85	1.14	4.68
Expected domestic price	1.00	0.05	0.85	1.14	4.79

Annex I: Simulation results for key variables

Table 12: Determinstic model simulation - Producer income, and changes in producer, consumer, and government welfare.

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 1						
Consumer welfare change	0.01	-34.28	31.80	55122.91	0.15	5.55
Producer welfare change, exclusive of risk benefit	-0.56	-54.08	40.76	-1796.05	-1.00	6.40
Government welfare change, without hedging	0.51	-31.25	40.81	1453.38	1.08	7.09
Government welfare change, with hedging	1.56	-15.98	40.77	382.05	3.03	12.34
Standard efficiency loss	-0.04	-24.77	21.38	-11690.16	-0.17	6.34
Producer income without stabilization program	202.16	123.99	293.42	13.79	0.23	0.10
Producer income with stabilization program	201.32	134.54	259.51	10.12	0.05	-0.12
Sample 2						
Consumer welfare change	-0.01	-34.21	37.20	-57132.73	0.34	4.36
Producer welfare change, exclusive of risk benefit	-0.58	-59.61	38.04	-1818.31	-1.08	5.44
Government welfare change, without hedging	0.55	-27.80	46.32	1415.19	1.40	6.97
Government welfare change, with hedging	1.68	-26.64	46.32	385.79	2.75	12.69
Standard efficiency loss	-0.05	-22.74	23.92	-10079.94	0.36	4.89
Producer income without stabilization program	200.53	121.81	313.76	14.42	0.43	0.73
Producer income with stabilization program	199.65	146.78	281.30	10.55	0.52	0.81
Sample 3						
Consumer welfare change	0.03	-34.41	30.56	27778.84	0.07	4.55
Producer welfare change, exclusive of risk benefit	-0.43	-50.09	41.31	-2471.12	-0.65	5.23
Government welfare change, without hedging	0.53	-30.50	40.69	1532.22	0.94	6.34
Government welfare change, with hedging	1.50	-22.53	40.68	453.33	2.30	10.07
Standard efficiency loss	0.13	-23.18	21.15	3907.51	0.14	5.07
Producer income without stabilization program	204.26	134.91	322.92	14.00	0.65	1.17
Producer income with stabilization program	203.62	149.63	277.01	10.14	0.47	0.51
Sample 4						
Consumer welfare change	-0.01	-36.23	33.41	-99999.00	0.04	5.04
Producer welfare change, exclusive of risk benefit	-0.60	-54.04	51.99	-1843.49	-0.68	6.03
Government welfare change, without hedging	0.51	-36.12	36.20	1572.73	0.71	5.85
Government welfare change, with hedging	1.59	-31.64	36.19	413.54	1.95	9.64
Standard efficiency loss	-0.10	-20.95	19.13	-4956.52	-0.17	4.62
Producer income without stabilization program	199.61	123.48	301.04	14.15	0.39	0.53
Producer income with stabilization program	198.71	140.66	258.46	10.02	0.23	0.19
Sample 5						
Consumer welfare change	-0.17	-38.99	29.78	-4211.82	-0.42	5.79
Producer welfare change, exclusive of risk benefit	-0.28	-44.98	46.91	-3524.04	-0.29	5.30
Government welfare change, without hedging	0.28	-33.47	36.00	2537.20	0.37	5.51
Government welfare change, with hedging	1.29	-23.22	35.93	442.00	1.98	9.35
Standard efficiency loss	-0.17	-25.55	19.17	-2743.89	-0.53	5.88
Producer income without stabilization program	202.73	117.39	287.29	14.19	0.20	-0.04
Producer income with stabilization program	202.31	149.88	273.41	10.98	0.29	-0.17
Sample 6						
Consumer welfare change	-0.02	-37.21	41.51	-40792.50	-0.11	5.04
Producer welfare change, exclusive of risk benefit	-0.63	-68.61	50.41	-1822.79	-0.59	6.63
Government welfare change, without hedging	0.54	-38.72	47.14	1541.62	0.66	6.72
Government welfare change, with hedging	1.70	-31.82	47.07	408.37	1.81	10.70
Standard efficiency loss	-0.11	-23.21	23.39	-4615.30	-0.25	4.55
Producer income without stabilization program	198.42	130.46	323.86	14.74	0.49	0.61
Producer income with stabilization program	197.48	145.97	261.54	10.35	0.09	-0.48

Annex I: Simulation results for key variables

Table 12: Deterministic model simulation - Producer income and changes in producer, consumer, and government welfare (continued.)

Sample	Mean	Minimum	Maximum	% CV	Skewness	Kurtosis
Sample 7						
Consumer welfare change	0.02	-41.07	28.12	40471.75	-0.21	5.33
Producer welfare change, exclusive of risk benefit	-0.47	-43.07	52.96	-2021.50	-0.33	5.16
Government welfare change, without hedging	0.49	-39.99	33.18	1458.63	0.61	6.31
Government welfare change, with hedging	1.46	-30.70	33.16	393.11	1.97	9.33
Standard efficiency loss	0.03	-28.09	18.24	14825.80	-0.19	6.12
Producer income without stabilization program	197.38	130.55	312.77	14.58	0.67	0.87
Producer income with stabilization program	196.67	136.96	287.16	11.30	0.65	0.99
Sample 8						
Consumer welfare change	0.00	-29.61	35.73	99999.00	0.20	4.38
Producer welfare change, exclusive of risk benefit	-0.47	-55.55	34.26	-2117.39	-0.86	5.01
Government welfare change, without hedging	0.52	-26.60	42.17	1395.23	0.88	4.63
Government welfare change, with hedging	1.62	-13.55	42.17	361.62	2.47	9.03
Standard efficiency loss	0.05	-20.01	22.34	8999.91	-0.02	3.62
Producer income without stabilization program	201.64	124.00	302.86	14.63	0.43	0.12
Producer income with stabilization program	200.93	142.43	281.83	11.17	0.47	0.38
Sample 9						
Consumer welfare change	-0.14	-41.46	42.78	-6220.02	-0.21	4.45
Producer welfare change, exclusive of risk benefit	-0.39	-69.52	46.88	-3104.76	-0.48	4.99
Government welfare change, without hedging	0.42	-35.89	50.08	2133.22	0.61	5.70
Government welfare change, with hedging	1.61	-24.47	50.08	448.77	2.13	10.01
Standard efficiency loss	-0.11	-26.66	23.34	-4960.49	-0.40	4.70
Producer income without stabilization program	201.03	119.81	316.78	15.38	0.51	0.48
Producer income with stabilization program	200.45	148.92	273.96	11.26	0.46	0.04
Sample 10						
Consumer welfare change	-0.03	-33.15	32.84	-27005.83	-0.02	5.02
Producer welfare change, exclusive of risk benefit	-0.53	-57.24	37.99	-1906.42	-0.76	5.95
Government welfare change, without hedging	0.44	-25.96	34.07	1648.53	0.70	5.17
Government welfare change, with hedging	1.47	-19.39	34.06	393.00	2.29	9.12
Standard efficiency loss	-0.12	-21.27	17.92	-3743.15	-0.33	4.56
Producer income without stabilization program	198.53	126.84	290.78	13.73	0.37	0.45
Producer income with stabilization program	197.74	140.39	267.19	10.02	0.19	0.22

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